PORT

Volume 2

on the Yellowstone Basin and Adjacent Coal Area LEVEL B STUDY

Upper Yellowstone

MONTANA

Missouri River Basin Commission
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mrbc

The Missouri River Basin Commission is the principal agency for the [illegible] interstate, local and nongovernmental plans for the development of water and related land [illegible] in the area served by the Missouri River and its tributaries. As an independent regional [illegible] it also provides a forum in which States meet with Federal agencies to [illegible] water and related land resources planning. The Commission's Chairman is appointed by the President; the Vice-Chairman is elected from among State members.

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General Report

YELLOWSTONE RIVER BASIN AND ADJACENT COAL AREA LEVEL B STUDY

UPPER YELLOWSTONE

MONTANA

Missouri River Basin Commission
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Jeffrey White

Jeffrey White
Yellowstone Level B--Montana

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CHAPTER I

INTRODUCTION

Background and Authority

The Missouri River Basin Comprehensive Framework Study, published by the Missouri Basin Inter-Agency Committee in December 1971, stated that the principal planning objectives for the Yellowstone Basin were: "the intensification of agricultural production and the processing of agricultural products; development of industrial processing of coal; and expansion of the recreation and tourist industry."

Shortly after completion of the Framework Study, the national energy crisis created increasing needs for careful resource planning in the Yellowstone Basin Area; this together with other recognized needs was the basis for initiation of a number of programs and studies. In general, these studies emphasized the need to follow a comprehensive plan in making resource-use decisions and recognized the need to develop an updated comprehensive/coordinated plan at the earliest possible date.

In February 1974, the Missouri River Basin Commission reacted to the need for a Yellowstone study and gave a high priority to its initiation. On April 1, 1974, a request was submitted to the Water Resources Council for funds to develop a Proposal to Study (PTS). At the May 1974, Commission meeting, a motion was approved by consensus which directed the MRBC Chairman to appoint a special Action Task Force for the Yellowstone River Basin and Adjacent Coal Area.

The Action Task Force proposed that a Level B type study be undertaken. A PTS was prepared and submitted to the Water Resources Council

in July 1974, with a request by the MRBC Chairman for funds to initiate the study in FY 1975.

Funds for initiation of the study were not made available for a FY 1975 start. Thus, the proposal was deferred, but with a priority consideration for FY 1976 funding. The Yellowstone Study was one of two new Level B starts that the President recommended in his FY 1976 budget request. Congressional approval resulted and an appropriation of funds for the Study was provided in December 1975. Work on the Level B Study was begun in early 1976.

Authority for the study is found in the Water Resources Planning Act of 1965 (P.L. 89-80, 42 U.S.C. 1962, as amended) and Section 209 amendments of the Federal Water Pollution Control Act of 1972 (P.L. 92-500, 86 Stat. 816). A Level B Study is regional or river basin in scope and involves a reconnaissance-level evaluation of water and related land resources for the selected area. The intent of a Level B Study is to: (1) resolve the complex problems identified by framework studies and assessments; (2) focus on near and midterm (10 to 25 years--base year is 1975) needs; (3) involve federal, state, and local interests in plan formulation; and (4) identify alternative plans and recommend action plans or programs to be pursued by individual federal, state, and local entities.

Purpose of the Study

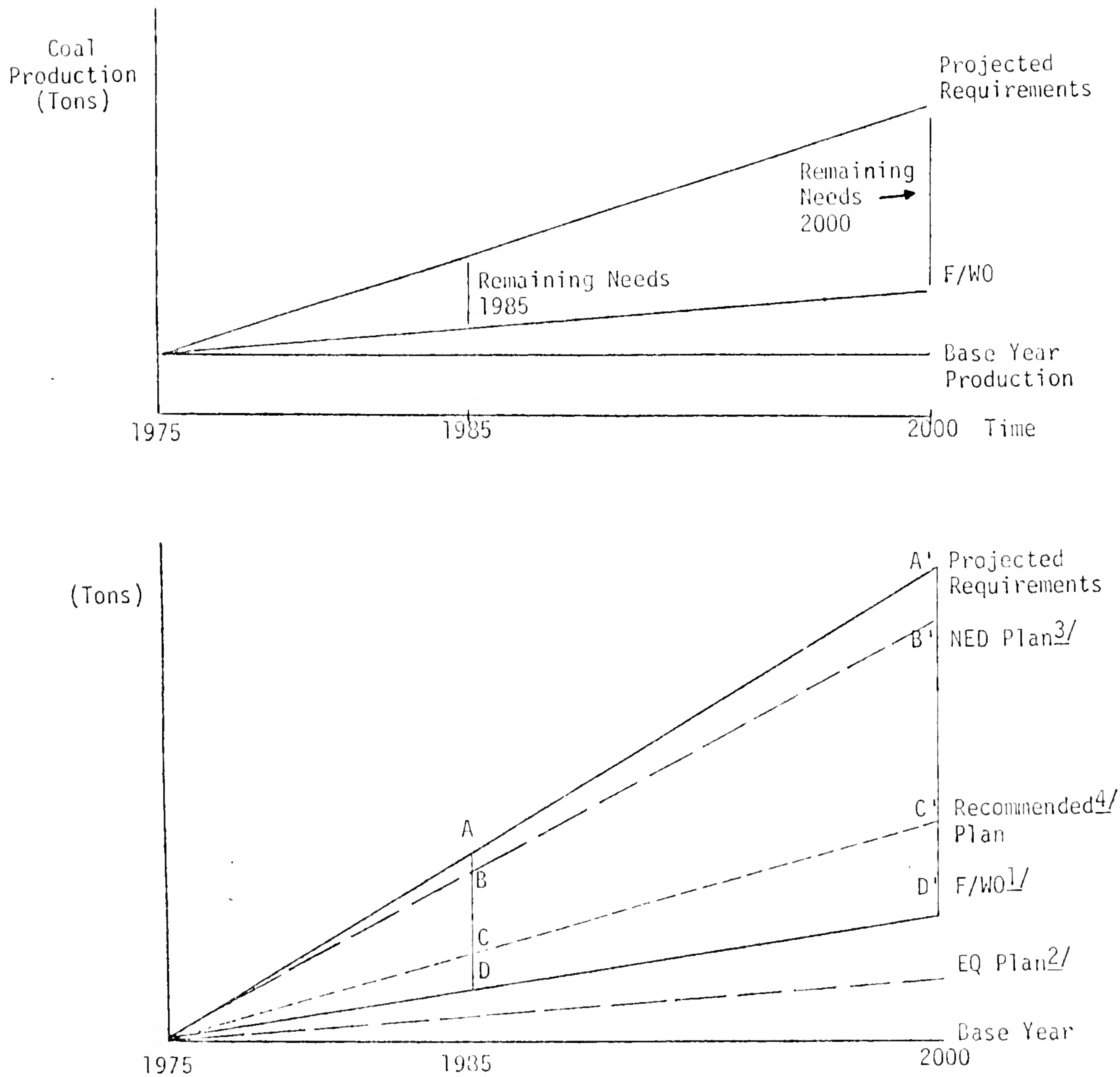
The purpose of the Level B Study is to promote the quality of life by: (1) enhancing the quality of the environment through the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems; and (2) enhancing national economic development by increasing the value

of the Nation's output of goods and services and improving national economic efficiency. The goal of enhanced environmental quality (EQ) and that of expanded national economic development (NED) are equal partners in the Level B planning process.

The planning process (see Figure I-1) includes the development of: (1) projected requirements (i.e, resources necessary to satisfy a water-related need); (2) the future "without" situation (F/WO), which describes development of an area in terms of future private endeavors and ongoing government programs in the absence of a plan; (3) the remaining needs that are not met by the F/WO (the remaining needs may be defined as the difference between the projected requirements and the F/WO, or Projected Requirements minus F/WO = Remaining Needs); (4) the NED and EQ plans which are initiated through local, State, or Federal actions to meet the remaining needs; and (5) the Recommended Plan which evolves from the combination of the EQ and NED plans. The Recommended Plan does not necessarily have to satisfy all of the remaining needs. If it is the judgment of the planning group (State Study Team, see below) that the quality of life in the planning area would not be promoted by satisfying certain remaining needs (e.g., massive coal development to satisfy the needs of other regions), then the group may choose some level of development more compatible with desires of the planning area's population.

The priorities and preferences of the various individuals affected will vary and, accordingly, there will likely not be full agreement among all affected on whether certain effects are beneficial or adverse, or on the relative trade-offs between objectives. However, when any plan is recommended from among the alternative EQ and NED plans, there is an implicit expression of what is considered to be the affected group's priorities and preferences.

Figure I-1. Example of Possible Planning
Sequence for Coal Development



1/ Under the F/WO situation, remaining needs are AD, in 2000, A'D'.

2/ The EQ Plan would constrain private development to less than the F/WO.

3/ The NED Plan come nearest to satisfying remaining needs only AB and A'B' remain.

4/ The Recommended Plan satisfies only CD and C'D' and would result in the production of the amounts AC and A'C' being shifted to another coal area.

Scope of Study

Although the Level B Study is new, water and related land planning is not starting anew in the Study Area. Planning agencies at all levels of government have already produced a baseline of data from studies conducted at various investigative levels. In most respects, plan formulation for the Level B Study has involved the reconsideration, reanalysis, reformulation, and rethinking of previously studied programs and projects into alternative plans which are responsive to changing needs and to evolving state, regional, and national goals. The intent has been to complete an analysis in sufficient detail and depth only to provide a reasonable and implementable overall plan, subject to the findings of Level C studies (i.e., feasibility studies) of each element of the plan.

Organization of Study

The Missouri River Basin Commission was responsible for the conduct, supervision, and management of the study. Funding of the Federal portion of the study was through the Water Resources Council to the Missouri River Basin Commission. State participation was funded through regular channels in each State. Public participation was funded by the organizations or individuals participating, except that the mileage costs to and from meetings were paid by the Commission for those organizations or individuals that requested it.

Study Direction

The Study Manager was given full authority and responsibility by MRBC to conduct the study, serving under the general supervision and direction of the MRBC Director of Planning and Technical Services. The Study Manager developed workplans, budgets, and schedules for completion of task activities; reviewed and evaluated completed work assignments,

reports, and studies for quality control, technical adequacy, integration into overall study efforts, compliance with work plan objectives and compliance with WRC Principles and Standards; and prepared recommendation and reports on results of the study efforts. Further, the Study Manager served as Chairman of the Management Group, which advised him on overall management guidance, direction, and control for the study effort.

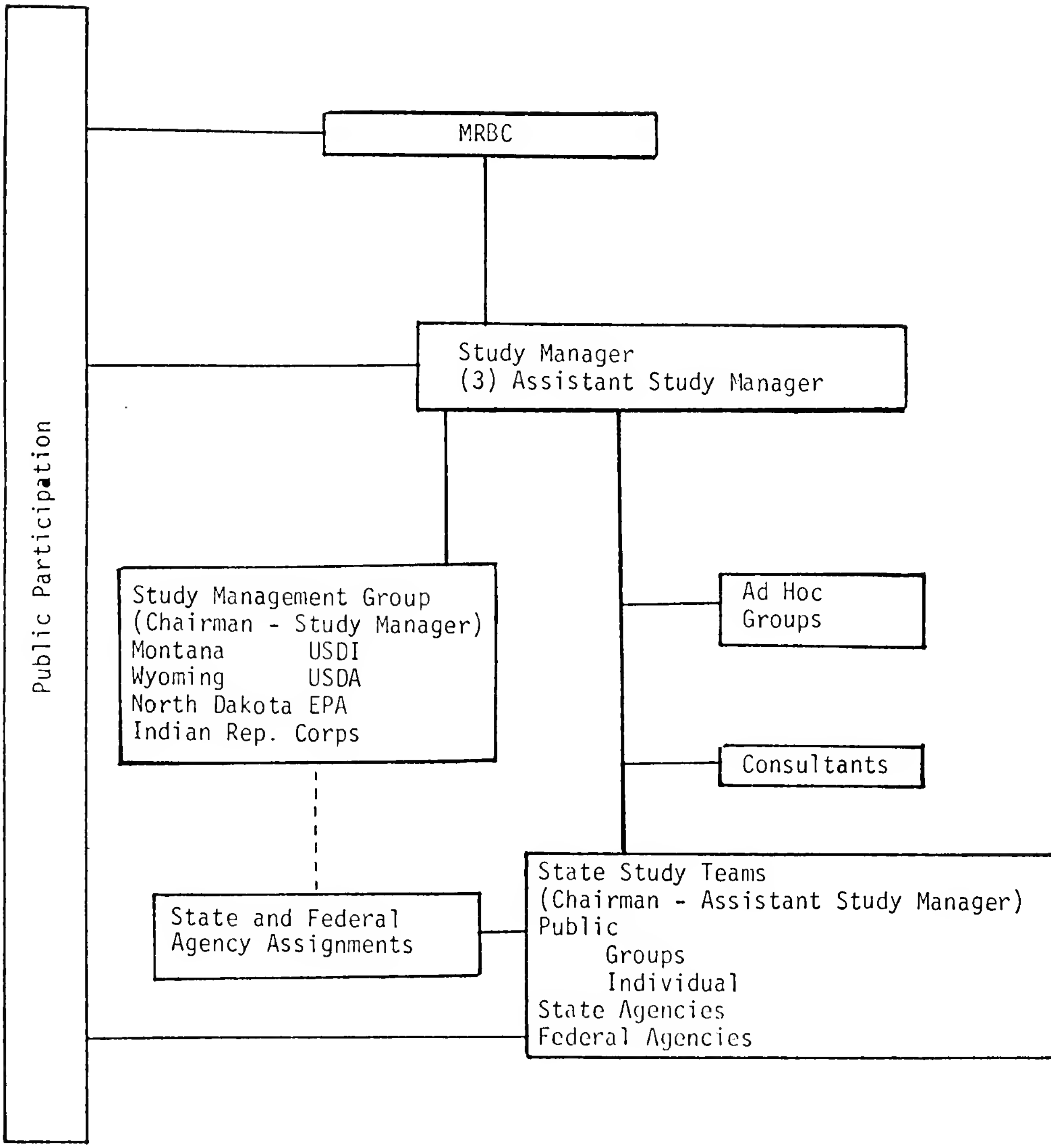
The Study Manager was assisted directly by three Assistant Study Managers. Each of these served as coordinator of planning, and of work activities of the various task groups and study participants, in the respective State of assignment. They also maintained continuing liaison with designated representatives of governmental and nongovernmental entities in their respective states for purpose of delineating and expediting study inputs and outputs.

The Manager and Study Office were located in Billings, Montana, with state offices located in Helena and Billings, Montana; Cody, Wyoming; and Bismarck, North Dakota. Figure I-2 displays the study organization.

Management Group

The Management Group established for the study was composed of the Study Manager and one representative from the Corps of Engineers, Environmental Protection Agency, U.S. Department of Agriculture, and the Federated Indian tribes, and two representatives from each State and the Department of the Interior. The primary function of the Management Group was to mold the seven area plans into a plan for the complete Study Area and provide guidance on management and direction for the study effort. In addition, it provided study performance evaluation, critique, and monitoring and control from a resource allocation context. The Group thus provided assistance to the Study Manager in policy formulation, direction, and study problem resolutions.

Figure I-2. Level B Study Organization



Ad Hoc Groups

During the early phases of the study, certain specific tasks were assigned to ad hoc groups. These groups were composed of agency representatives (Federal, State, local, etc.) with a given expertise and capability to effectively perform the task assignments. The assigned functional areas included: specification of the basic needs of agriculture, outdoor recreation, fish and wildlife, instream flows, energy, and others. Each group prepared a report defining: (1) base conditions (1975); (2) projected future requirements (1985 and 2000); (3) the portion of those requirements that may be satisfied through private initiative; and (4) the remaining needs to be met by time frame 1975-1985 and 1985-2000. Upon completion of their given assignments, the groups were disbanded.

State Study Teams

Plan development, analysis, and associated public participation were handled through State Study Teams under the direction of the Assistant Study Manager in each state. State Study Teams were composed of representatives from Federal and State agencies, interest groups, and industry--as well as private individuals.

The State Study Teams have had the most important role in the study in that they formulated the alternative and recommended plans for each planning area. A typical sequence of events for the State Study Team in an individual planning area was:

1. Preparation of a background report.
2. Development of issue papers by individual agency, group, or citizen involved in the study. Issue papers defined the future of the area without additional federal or state involvement; the problems and needs this would leave unfulfilled; necessary programs to meet those needs; and reconnaissance benefits and costs of suggested programs.
3. Development of Ad Hoc Work Group Reports. The ad hoc group presentation was primarily technical and designed to cover

the entire Study Area with a consistent description of needs in each functional area (e.g., instream flows, flood control, and agriculture). These needs were then disaggregated to individual planning areas where possible.

4. Formulation of alternative plans emphasizing National Economic Development (NED), Environmental Quality (EQ), and State-Regional Development (SRD) objectives and the development of a recommended plan, with involvement of the public. State Study Team meetings were held in the various planning areas in which the information supplied by the issue papers and ad hoc group reports was evaluated and analyzed as part of the planning process.

State Involvement

This Level B study effort has been oriented to a high degree of State agency participation, both in terms of task performance and policy guidance through service on the Study Management Group and on State Study Teams. Additionally, each of the respective states assumed a major role through its cost-sharing portion of the total study effort. In some instances, resources expended on these state-oriented efforts provided input over and above that of the Level B requirements. Similarly, efforts undertaken on the Level B study will provide added information for use in the various state plans and programs.

Public Participation

A continual emphasis on public awareness, involvement, and participation is called for in the U.S. Water Resources Council's Principles and Standards, which provided the basic guidelines for this study. Considering the large geographic size and diversity of interest in the Study Area, it was deemed inadvisable to structure a formal organizational entity such as a Citizens Advisory Committee or Citizens Task Force. Interest groups within the area (both developmental and environmental) were already fairly well organized and operationally established, and some of these organized groups sent representatives to Study Team meetings. Members of the general public also participated directly on the Study Teams.

Interstate and Study Area Planning Coordination

Planning coordination for drainage areas crossing state boundaries were coordinated in three ways: (1) the Assistant Study Mangers for the respective states maintained constant watch, directly and through the Study Manager, on the activities in their respective portions of the Study Area; (2) joint planning meetings between members of affected study teams were scheduled when conflicts were evident in planning philosophies or resource availabilities; and (3) the Assistant Study Managers were called upon by the Study Manager to report to the Management Group at appropriate times during the plan formulation process.

This process provided adequate coordination to provide overall compatability, but at the same time permitted enough freedom at the local and state levels to allow the plans to reflect local conditions and preferences.

A more difficult coordination problem revolved around the multitude of water and/or related land studies being undertaken by individual local, State, and Federal agencies. Many of these studies were related to some single objective, and had a schedule that did not correspond to that of the Level B Study. Attempts were made to coordinate activities with such programs as the "208" water quality studies; the regional coal-related EIS endeavors, and BLM and Forest Service land allocation studies. Even so, the differences in timing often made interchange of data and analytical results very difficult, though representatives of such ongoing studies attended Study Team meetings. As a result of these difficulties, it seems quite likely that the conclusions of some of these ongoing studies may not agree fully with some details of the Level B analysis. On the other hand, the coordination and interchange that has been possible has been

of great help in at least keeping basic philosophies and broad objectives identified and coordinated, so that differences in study outputs, if they occur, would be matters of detail that can be accommodated within the framework of future planning and implementation efforts.

Study Area Description

The Yellowstone Study Area encompasses the 37 counties in Montana, Wyoming, and North Dakota which are wholly or partially within the hydrologic boundary of the Yellowstone River Basin, plus 13 counties in North Dakota and two in Wyoming which are outside the hydrologic boundary but within the coal resource area associated with the Yellowstone Basin. Figure I-3 identifies the counties in each state that are involved in the study. The study does not include Yellowstone National Park, although a substantial part of the Park is drained by the Yellowstone River. The counties are shown below:

Montana

Big Horn	Fallon	Musselshell	Rosebud
Carbon	Gallatin	Park	Stillwater
Carter	Garfield	Powder River	Sweet Grass
Custer	Golden Valley	Prairie	Treasure
Dawson	McCone	Richland	Wibaux
	Meagher		Yellowstone

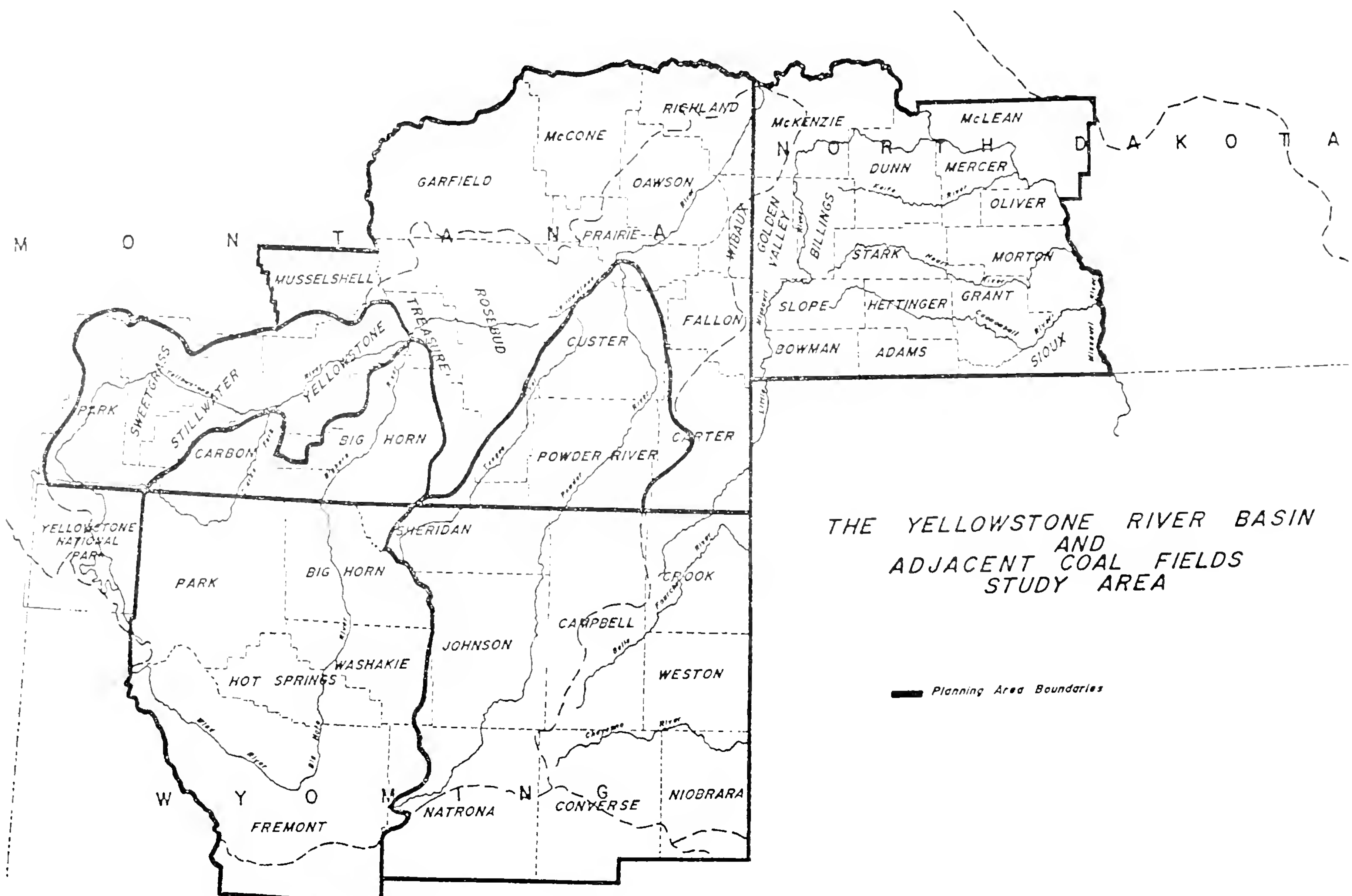
Wyoming

Big Horn	Fremont	Niobrara	Teton
Campbell	Hot Springs	Park	Washakie
Converse	Johnson	Sheridan	Weston
Crook	Natrona	Sublette	

North Dakota

Adams	Golden Valley	McLean	Sioux
Billings	Grant	Mercer	Slope
Bowman	Hettinger	Morton	Stark
Dunn	McKenzie	Oliver	

Figure I-3. Composition of Level B Study Area



For the purposes of this study, the total area, which covers about 123,375 square miles or 78,959,645 acres, has been subdivided by drainage into the seven planning areas listed below and delineated on Figure I-3.

Montana

Mainstem of Yellowstone River above the Bighorn River (Upper Yellowstone, Montana)
Mainstem of Yellowstone River below the Bighorn River, and Adjacent Coal Area (Lower Yellowstone, Montana)
Clarks Fork of Yellowstone and Lower Bighorn Rivers (Clarks Fork-Bighorn, Montana)
Tongue and Powder Rivers (Tongue-Powder, Montana)

Wyoming

Wind, Bighorn, and Clarks Fork Rivers (Northwest Wyoming)
Northeast Wyoming (Northeast Wyoming)

North Dakota

Little Missouri, Knife, Heart, Cannonball, Grand, and Yellowstone Rivers and Adjacent Coal Area (North Dakota Tributaries).

Study Area Objectives

Many of the problems and needs of the Yellowstone Study Area were documented in the Missouri River Basin Comprehensive Framework Study Report, and others have surfaced since that time.

In the main, potential conflicts are between those uses which divert water from the streams and rivers and those uses that require instream flows. Another conflict which affects all other issues is the Federal vs. the State water rights partially as manifested in the Indian and Federal reserved water rights questions.

To better define the areas of potential problems, the staff identified what appeared to be the major water related issues in the Study Area. They were the:

1) Maintenance and expansion of food and fibre production.
2) Maintenance of instream flow levels and water quality.

3) Impact of energy development upon the area's water resources.
4) Indian water resource use.

Upon the definition of these issues, the Level B staff addressed each in a paper. The papers provided guidance to the Management Group and State Study Team as how to dispose of the issues. These papers, coupled with agency and individual issue papers and the ad hoc reports, led to the analysis presented in the following chapters of this study.

CHAPTER II

NATURAL RESOURCE BASELINE

The purpose of this chapter is to acquaint the reader with the manmade and natural characteristics of the Upper Yellowstone Planning Area. The following discussion is not intended to be in-depth, but rather to survey man and his habitat as they exist in this planning area.

Description

The planning area includes the Yellowstone River and its tributaries (except for the Clarks Fork) above the mouth of the Big Horn River and below the point at which the Yellowstone River leaves Yellowstone National Park near Gardiner. The area lies entirely within Montana and encompasses all or part of ten Montana counties. Table II-1 illustrates the composition of the area.

Of the total 5,900,783 acres of land in the area, approximately 90 percent or 5,267,228 acres is found in Park, Stillwater, Sweet Grass, and Yellowstone Counties.

Area History

Since the coming of the first white men, the Yellowstone Area has been changed dramatically from a wilderness, abounding in animal life, to a sedentary agricultural area.

Pierre and Louis Verendrye and two others were the first to enter the Area, while searching for a route to the Pacific Ocean for the French Government. From the party's sketchy journals, it is believed that they entered the basin north of Miles City and traveled in the Yellowstone, Powder, Tongue, and Little Missouri river valleys.

Table II-1. Land and Water Areas by County, Upper Yellowstone, Montana 1/

County	Water Area: Over 40 Acres	Water Area: Under 40 Acres	Water Area: Total (Acres)	Land Area (Acres)	Total Area (Acres)
Big Horn	1,673	57	1,730	262,270	264,000
Carbon	580	570	1,150	149,850	151,000
Gallatin 2/	1,096	261	1,357	118,643	120,000
Golden Valley 2/	---0---	26	26	5,974	6,000
Meagher 2/	---0---	105	105	36,895	37,000
Musselshell	---0---	77	77	59,923	60,000
Park 2/	3,121	3,568	6,689	1,626,003	1,632,692
Stillwater 2/	4,477	861	5,338	1,068,662	1,074,000
Sweet Grass 2/	4,949	540	5,489	1,024,042	1,029,523
Yellowstone	14,133	458	14,591	1,548,521	1,563,112
TOTALS	30,029	6,523	36,552	5,900,783	5,937,327

1/ Source: Land Use Update, Land Use Ad Hoc Work Group, January, 1976.
2/ Area in Yellowstone River drainage only.

Larocque's expedition in 1805 was the second to enter the Yellowstone Area and was prompted by fears that the planned expedition by Lewis and Clark would interfere with fur trading activities of the British Northwest Fur Company. The Company sent Larocque into the Area, a year ahead of Lewis and Clark, in an attempt to gain a monopoly on the region's fur trade.

The third exploration and certainly the most valuable from a scientific standpoint was the Lewis and Clark Expedition. In the latter part of June 1806, Lewis and Clark, on their return from the west coast, decided to divide their party into two groups. Part of the group traveled north with Lewis and explored the Marias River, while Clark and some of his men explored the Yellowstone. They met again at the confluence of the Yellowstone and Missouri.

Clark's party entered the valley by crossing the Bozeman pass, between Bozeman and Livingston, and arrived at the river about a mile below the present community of Livingston. They traveled downstream for four days looking for trees suitable for making canoes. From that point, some of the party left and traveled overland to about Pompeys Pillar east of Billings. They, too, were forced to fashion floating craft after losing their horses and to travel the remainder of the trip down the Yellowstone on the water.

Other explorations followed for more mercenary reasons rather than the scientific purposes of Lewis and Clark. At Mandan, on the return trip of Lewis and Clark, two trappers from Illinois convinced John Colter of the exploration party to join them and return to the Yellowstone country. Their partnership was short-lived for after wintering where the Clarks Fork River joins the plains, Colter left the two to go to St. Louis. At the mouth of the Platte, however, he rejoined three former Lewis and Clark party members and agreed to return to the Yellowstone with them and another man, Manual Lisa, who wanted to establish a fur trading post. Fort Lisa was founded at a place

previously designated by the Lewis and Clark Expedition as a good site for a fort at the mouth of the Bighorn River. From this fort these men and others eventually explored all of the Yellowstone Area. The Lewis and Clark and Larocque expeditions had the direct and immediate effect of opening the Rocky Mountain area to a thriving fur trade.

During this same period, the Crow Indians had come westward as far as the mouth of the Bighorn River; by 1800 they had displaced the Shoshone throughout the area. The Fort Laramie Treaty of 1868 set forth the original Crow Indian Reservation boundaries which included all lands in Montana lying west of the 107th Meridian and South of the midchannel of the Yellowstone River.

Few white men saw the area until trails were blazed by Jim Bridger and John Bozeman, in 1864, that linked the North Platte River with the Three Forks of the Missouri River.

Shortly after the Civil War, Yellowstone National Park was created by an act of Congress in 1872. This was initiated by early reports of its scenic wonders and later the results of exploration by a team of geologists in 1871. Congress maintained its interest in the Upper Yellowstone area, for in the next year, 1873, investigations were undertaken on the feasibility of irrigation.

In 1874, commercial river boats began carrying cargo and passengers upriver as far as the present site of Billings, Montana; however they could not survive the railroad's competition and were abandoned in 1884, two years after the Northern Pacific Railroad reached Billings.

By now the southern herd of Buffalo, estimated to be four million head, was gone. The last of the northern herd, perhaps one and a half million head were to die under the guns of hide hunters by the year the railroad reached Billings. With the extermination of the buffalo and the formation of

reservations, the Indians could no longer survive as they had through generations. The Federal Government contracted with cattlemen to supply beef to the Indians. This action created a new cattle market close at hand. Cattle numbers increased and the grass from unusually favorable rainy years helped inflate their numbers.

In 1884 a severe drought began and continued through 1886 and into the worst winter the cattlemen had experienced. By the spring of 1887 the cattle industry had been almost wiped out. This tragedy was recorded by the artist Charles M. Russell, in his dramatic painting the "Last of the Five Thousand." In the years that followed, the farm-based livestock operation replaced the year long use of the range. Harvesting of forage for winter feed opened the way for the livestock industry to develop into a stable enterprise.

Mining, once a mainstay of the Upper Yellowstone area, started at Cooke City, in what was to prove to be a short-lived gold strike. Gold diggings at Emigrant led to the founding of the town of Livingston in 1881. The town later expanded in 1883 with the coming of the railroad to become one of the more important cities in the area.

By this time, interest in irrigated and dryland farming had developed. High prices during World War I brought about cultivation of thousands of acres of new land, which were later idled due to low grain prices. These abandoned lands later were rebroke, and farmed together with thousands of additional acres until the depression which, along with a series of severe drought years, created hardships for dryland farmers. During these depression years of the 1930's, many thousands of acres of marginal farm land reverted to the U.S. Government under the terms of the Bankhead-Jones Act.

Since the depression years, the area has re-established a sound agricultural base, with livestock production becoming the major agricultural activity.

Billings has grown to be the major trade center of the entire Yellowstone area, which has led to a development of a more diversified economy in Billings and Yellowstone County than in Montana as a whole.

Natural Resources

Physiography and Geology

The Yellowstone River heads at an elevation of 10,000 ft. just south of Yellowstone National Park in Wyoming. Dropping nearly 2,000 ft. in its first ten miles, it then flows on gentle gradients for approximately sixty miles through the center of the Park before forming Yellowstone Lake at 7,750 ft.

Once out of Yellowstone Lake, the gradient increases slightly until the eightieth mile where the river plunges over the Upper and Lower Falls. Below the falls the river passes through the Grand Canyon of the Yellowstone dropping another 1200 ft. to the northern boundary of Yellowstone National Park. From there the river flows northward to Livingston, Montana, where at an elevation of 4,900 ft. it turns to the northeast with gentler gradients. It drops to an elevation of 2,800 ft. at its confluence with the Bighorn River near Custer, Montana.

The Upper Yellowstone Planning Area begins at the point where the Yellowstone River leaves Yellowstone National Park near Gardiner and ends near Custer, at the mouth of the Bighorn. The boundaries of the Upper Yellowstone system are: The Upper Missouri drainage to the west; the Musselshell drainage to the north; and the Clarks Fork and Bighorn drainages to the south and east.

The area is dominated by two major physiographic provinces--the Northern Rocky Mountain and the unglaciated Missouri Plateau. The Northern Smooth High Plains of the Missouri Plateau comprise nearly half of the total area;

the North Rocky Mountains, related foothills, and alpine areas make up the remainder.[1/]

In general, the unglaciated Missouri Plateau is level to slightly undulating. However, rough and broken terrain is frequently encountered in the form of a succession of bluffs and terraces along the Yellowstone and other drainages.

The greatest portion of the sedimentary formations are young; they lie almost completely rimmed by relatively narrow Tertiary deposits of the Fort Union formation. Cupped within the Fort Union rim are the Cretaceous shales of the Hell Creek formation--dark sandstone interbedded with greyish and greenish clays and mudstone--formed during the Age of Reptiles under the once-large, shallow inland lakes. The prehistoric lakes and swamps gave origin to huge tonnages of lignite and subbituminous coals in the eastern end of the area.

Northern Rocky Mountain elevations vary from approximately 5,000 ft. at the base to over 11,000 ft. in isolated volcanic peaks of the Crazy Mountains. A series of peaks in the Absaroka Mountains reach above 12,000 ft. in elevation.

Roughly one-third of the Absaroka Range is composed of one structure--a monolithic ancient granite formed in Pre-Cambrian time. It totals nearly one million acres, the only major single geologic formation in the entire area formed earlier then the Cretaceous period. The eastern front of the Absarokas is a vast geologic fault extending scopes of miles as a remnant of the mountain building of the Larmide Revolution.

North of Yellowstone Park, approximately half of the exposed rock is water-laid, reworked volcanic material. Volcanic flows or isolated granite stocks make up the remainder.

The Cretacious shales of the valleys are intermixed with very recent

1/ See Land Use Update, Land Use Ad Hoc Work Group, January, 1976.

Quaternary deposits of sand and alluvium.

Climate[2/]

The Upper Yellowstone area is characterized by a continental climate, which is modified by the land forms that exist there.

Precipitation averages from 12 to 14 inches on the plains. The mountainous portions of the area receive larger amounts of precipitation--from 20 to 40+ inches--much of which falls as snow and leaves the mountains as spring runoff. The majority of the precipitation falls in the April-September time period--the growing season.

In general, the growing season varies from 30-110 days in the mountains and foothills to 110-140 in the plains and river valleys. Severe hailstorms may occur throughout the growing season; the worst months for hail are June and July.

Mean temperatures in the Upper Yellowstone are the highest in the State. Big Timber, in Sweet Greass County, has the highest yearly mean temperature in Montana. The Upper Yellowstone valley lies within a "chinook belt"--characterized by warm balmy winds that can dramatically raise the winter and spring temperatures by tens of degrees; the area is known for its blustry winds which, in the past, have been recorded near 100 miles an hour.

In general, winters are cold, but snow seldom lies in a continuous cover for any great length of time. Temperatures can be severe, with temperatures dropping to as much as 40 degrees below zero. Summers are typified by hot days and cool nights. Daytime temperatures reach 100 degrees for a few days during the summer in the lower portions of the area.

2/ The information found here and in many of the following sections of this Chapter has been taken from one or more of the Bureau of Land Management's several Missouri River Basin Investigations.

Soils and Vegetation

Soils

About one-third of the planning area is covered by soils that have good potential for producing crops or pasture. These soils are fertile, light-brown to dark brown in color, and have a gravelly profile. Soil depths range from shallow to moderately deep. Such soils have been developed where precipitation has been relatively high and able to at least support natural grasses. The deeper soils are suited to cultivation.

Podzolic soils of low fertility have developed under the coniferous forests of the mountains and foothills under cool and moist conditions. Similar, but more fertile gray-brown forest soils are found on gentle slopes or in warmer locations.

In mountainous areas above the timber line, alpine soils are formed over permanently frozen sub-strata in a severe climate of high winds and deep snows. Alpine soils are shallow, not usually over 12 inches deep and high in organic matter; more favorable sites may form meadow soils of shallow to moderate depth, with a high organic matter content. Vegetation is low growing, usually as grass or grass-like plants amid the rock outcrops. Forage is utilized principally by wildlife.

The remaining soils of the area have either undeveloped or immature profiles. Some are highly productive like the alluvial soils of the valleys. Other soils, found in drier zones of the plains have undeveloped profiles because of an excess of salts. Use of these saline soils is limited to grazing by livestock and wildlife.

Vegetation

About 50 percent of the area remains in grassland; forested lands cover nearly 30 percent--mostly in the western portion. Fourteen percent of the area is under cultivation with the remainder being made up of alpine

tundra and barren lands.

Rangeland conditions have varied remarkably little since the early days of exploration according to the early accounts of Clark and Stuart. Today, as then, grasses dominate the range. Bluestem wheatgrass, needle-and-thread,, bearded bluebunch wheatgrass, green needlegrass, Sandberg Bluegrass, and prairie junegrass are the most common grass species. Inland saltgrass and alkali sacaton are usually found on saline flats. Sagebrush, especially big sagebrush, is the dominant browse species; occasionally isolated patches of silver sagebrush assume a local importance on the lowlands. Serviceberry, chokecherry, mountain mahogany, aspen, snowberry, skunkbrush, greasewood, wildrose, and willows are common; influenced by topography or soils they concentrate in limited stands. All of these shrubs are grazed by domestic livestock and game animals.

Concentrations of poison plants are rare. Arrowgrass is the most important species. The deadliness of arrowgrass makes even the smallest patches a threat to the range. Prickly pear cactus is still growing in the same areas noted by the early explorers.

The forests are located primarily in the western portions of the area. About 58 percent of the 1.5 million acres of forest lands is capable of producing commercial supplies of wood products. About 20 percent of these commercial forest stands is not available for harvest due to limitations on access and logging, such as wilderness or other restrictive land classification. The remaining 42 percent of forest land is rated noncommercial--incapable of sustaining economic harvest due to adverse growth potential.

Minerals

The Upper Yellowstone has had a scattered history of hardrock mining since 1862 when gold was discovered near Gardiner in Park County. At present there exist no major hardrock mining activities in the area, although there

has been sporadic activity in the Stillwater Complex regarding the potential for mineral extraction.

The Stillwater Complex area contains 70 percent of U.S. chromite resources and over 20 percent of known U.S. platinum-group resources. There is also evidence of deposits of copper, iron ore, and nickel, and of anorthosite for aluminum production.

Several mining concerns recently have been carrying out exploration activities in the Stillwater Complex area of Stillwater and Sweet Grass counties. American Metal Climax, Inc., has been core drilling for platinum-palladium near Chrome Mountain in the Boulder River drainage in Sweet Grass County. The Anaconda Company has conducted a drilling operation over a two-mile area in the Stillwater River drainage in Stillwater County between the former Benbow and Mouat chromite mining properties. Reportedly, a few hundred million tons of ore have been determined with a 0.25 percent copper content, platinum values, and a chromite content allegedly similar to that mined previously during 1953-1961 (22-23 percent chromic oxide). Anaconda also has done some drilling on Chrome and Iron mountains between the West Fork of the Stillwater River and Boulder River in Sweet Grass County.

The Johns-Manville Corporation is currently carrying out intensive exploration by surface drilling and an exploration adit to ascertain the commercial importance of a platinum-palladium horizon on the West Fork of the Stillwater River. An environmental consulting firm has been retained to prepared an environmental assessment for a mining operation. While no schedule is yet known to exist of development, there have been indications that on-site facilities could include a mine, concentrator, and smelter.

In the past, metallic mineral production has been limited to a small amount of gold, silver, lead, zinc, and copper from the New World (Cooke City) and Jardine mining districts in Park County. Chromite was mined in

Stillwater County between 1953 and 1961 for government stockpiling at Nye under a contract negotiated with the Defense Minerals Procurement Agency. Mining ceased with completion of the agreement. The total value of the 900,000 tons of the chromite mined was $34.1 million, with 1960 output approximately $3.8 million and 1961 production $2.9 million. In 1974 the General Services Administration sold the entire stockpile at Nye. Shipments began with 200,000 tons in 1975 and will continue into the early 1980's.

Sand and gravel are the most important nonmetallics produced in the area, and most of the production comes from urbanized Yellowstone County. The production trend has been erratic, however, with a high of $2.8 million in 1970 and a low of $0.6 million in 1961. Output in 1974 was $1.4 million.

A small amount of crude oil has been produced in Yellowstone County from the Weed Creek and Wolf Springs oilfields. At the beginning of 1975, oil reserves in the Wolf Springs field, the only remaining producing field, were estimated by the Montana Board of Oil and Gas Conservation at 135,000 barrels. The only natural gasfields are found in Stillwater County in the North Lake Basin and Lake Basin gasfields. A small amount of natural gas is produced each year from the North Lake Basin. Although several exploration holes are drilled each year in the Upper Yellowstone Area, only a few small oil and gas fields are expected to be discovered in the future.

Park and Stillwater counties have small resources of coal in the Electric, Livingston, and Trail Creek fields. Production ceased between 1912 and 1914 and future output is not anticipated. The Bull Mountain coalfield in northern Yellowstone County has a demonstrated reserved base of 590 million tons of subbituminous coal (10,000-12,000 Btu's) which would have to be mined largely underground. No large amount of coal is expected to be produced there within the next 25 years.

Land Use

The Upper Yellowstone area contains a total of 5,937,327 acres within its boundaries. Approximately 847,003 acres of the total, or 14 percent are cultivated.

Agricultural

There are 723,223 acres of cropland in the area; the majority of those acres, 510,320, is non-irrigated. The remaining 212,903 acres of cropland, or 30 percent, are irrigated.

A total of 123,780 acres produce pasture; 53,220 of those acres are irrigated, while 70,560 acres produce dryland pasture.

Irrigated lands (i.e., crop and pasture) aggregate to 266,123 acres. The largest use of irrigated lands is for hay production, comprising approximately 75% of the total. Corn (for silage and grain) and sugar beets follow as major irrigated crops with barley, wheat, oats, and dry beans following in that order.

The main dryland crop grown is wheat which occupies roughly 55 percent of the total number of acres. Hay and barley are the other major dryland crops, followed by oats.

Non-Agricultural

Included as non-agricultural lands are: range, forest, urban and builtup, and barren lands (e.g., tundra). Rangeland accounts for more than 3.1 million acres which is three times that of cropland and twice that of forests. There are 222,400 acres of alpine tundra and barren lands and roughly 28,000 acres of urban and builtup lands in the area.

Land Ownership and Administration

Of the 5,937,327 surface acres that are included within the Upper Yellowstone area, 25 percent is federally owned and administrated. There are 36,552

surface acres of water in the area; 82 percent of this is controlled by the Federal Government. By land use, the Federal Government owns and administers: 11 percent of the area's range lands; 53 percent of the forest lands; all of the barren lands; a small amount of the urban and builtup lands (1,727 acres); and none of the agricultural lands (i.e., crop and pasture).[2A/]

Subsurface ownership and administration data are not available by planning area. However, Federal subsurface ownership and administration is available on a limited county basis.[3/]

State subsurface ownership and administration is available by township and range in the State Land Mineral Ownership Listing.[4/] These data have not been totaled by county and no data exist by drainage basin.

Fish and Wildlife Resources

The Upper Yellowstone area has an abundance of wildlife for the hunter, photographer, or sightseer.

Mule deer, whitetailed deer, elk, antelope, moose, mountain goats, and bighorn sheep are the major large species. Grizzly bears can be found in the mountain and plateau areas adjacent to Yellowstone National Park. Much of the mountainous area is being considered for classification as critical grizzly habitat by the U.S. Fish and Wildlife Service. Black bears are common in the mountains and foothills.

Mountain lions also inhabit the area. Coyotes and bobcats are common and provide considerable recreation and income to hunters and trappers. Other furbearers include muskrat, beaver, mink, weasel, marten, and otter. Fox and raccoons frequent the river bottoms and adjacent uplands.

Raptors are common. Breeding populations of redtailed hawks, golden

2A/ County by county data are provided in Ad Hoc Committee report entitled "Land Use Update," January 1976.
3/ U.S. Bureau of Land Management (BLM) State Office, Billings, Montana.
4/ Montana Department of State Lands, January 1976.

eagles, American kestrels, Cooper's hawks, sharp-shinned hawks, and other--including the bald eagle and osprey--are all found along the Yellowstone River.

The waterfowl habitat is excellent along major streams which attracts wintering and breeding population of geese and ducks.

Upland game birds' species include sage grouse, sharp-tailed grouse, ring-necked pheasants, gray partridges, chukar partridges, turkeys, blue-grouse, and ruffled grouse.

Numerous species of song birds and small mammals inhabit the area. There are four species that deserve special attention since they are endangered species: (1) the Northern Rocky Mountain wolf, (2) the black-footed ferret, (3) the American peregrine falcon, and (4) the whooping crane.

Both salmonid and non-salmonid fishing in the area is excellent.

There are two wildlife refuges: Hairstone National Wildlife Refuge and Halfbreed National Wildlife Refuge. Both of these refuges are located in the northern portion of Stillwater County and are primarily for waterfowl.

Outdoor Recreation Resources

Resident and non-resident recreation are major activities in the Upper Yellowstone area. In fact, the area has increasingly realized and taken advantage of the international drawing power of its natural resources. Although Yellowstone National Park has always been the number one attraction, many other places of outstanding opportunity exist. One such attraction is the Yellowstone River. It is the thread that ties this area together physically, economically, and recreationally.

The primary outdoor recreational activity in the planning area is sport fishing because of an abundance of quality trout fisheries. The best known of these fisheries is the Yellowstone River, a "blue ribbon" stream from the

boundary of the Yellowstone National Park to the town of Big Timber in Sweet Grass County. The mountain lakes of the Custer and Gallatin National forests provide additional fishing opportunities as well as hunting, camping, and other types of outdoor recreation. The proposed Beartooth Wilderness, including portions of both the existing Absaroka and Beartooth Primitive areas, provides a large continuous area for wilderness recreation.

No State parks or national recreation areas exist in this planning area; however, the river corridor between Livingston and Gardiner is a major access route to Yellowstone and Grand Teton national parks. Hot springs found in the upper reaches appear capable of providing greater developed and dispersed recreational opportunities and warrant additional investigation as a recreational resource.

Water Resources

Water Rights[5]

The Montana Water Use Act of 1973 provides a permit system for the appropriation and new use of surface and ground water, procedures for the determination and court adjudication of water rights existing prior to July 1, 1973, and the establishment of a centralized record system of all water rights.

Because of Montana's past lack of documentation concerning valid water use, water supply problems, and implications of industrial applications, the Montana Department of Natural Resources and Conservation (DNRC) decided that the initial determination of existing water rights would be in the Yellowstone

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5/ The sections discussing water rights, Federal and Indian water rights, water rights litigation, and the Yellowstone River Compact were taken from The Future of the Yellowstone River.....?, Montana Department of Natural Resources and Conservation, January, 1977.

River Basin. Field investigations of water right declarations, part of the process of preparing a recommendation to the district court which issues the preliminary and final decree for adjudication, have been underway since the summer of 1974 in the Powder River Basin.

The DNRC estimates that there will be a total of about 11,000 water rights recommended to the district court in the Powder River Basin. Of the 3,000 rights investigated so far, about 75 percent are use rights--rights which have never been filed. Prior to July 1, 1973, use was the only necessary requirement to establish a water right, and, except on an adjudicated stream, there was no necessity to file. Under the new law, of course, a permit must be obtained for the use of water or there is no right to that water.

The adjudication of the other three interstate tributaries (Tongue, Bighorn, and Clarks Fork Yellowstone) will be completed next. In fact, preparations for the determination of existing rights have begun in the Tongue and Bighorn river basins, but order for declarations are currently pending because of litigation in Federal court over Indian and Federal water rights. Adjudication of the mainstem of the Yellowstone River will follow.

Until the adjudication process is completed quantification of water rights is not possible. Water rights usually are not adequately reflected in historical flow records.

Yellowstone Moratorium

Under the Montana Water Use Act, new water rights are established through the issuance of permits by the Department of Natural Resources and Conservation. Originally, the Yellowstone Moratorium, enacted in 1974, suspended all large applications (diversions of over 20 cfs or storage of over 14,000 af) for water use permits in the Yellowstone Basin until

March 10, 1977; in addition, the Moratorium excluded reservations in the basin by Federal agencies for three years. However, since then, the Moratorium was extended to January 1, 1978, and Federal agencies were allowed to file reservation requests. The Board of Natural Resources requested further extension of the Moratorium to July 1, 1978, but the Supreme Court denied this request and staged proceedings until some undetermined date in the summer of 1978.

A substantial number of permit applications, all of which are primarily for industrial water use, were suspended. The language of the Moratorium emphasized the need for reserving water in the Yellowstone Basin for the protection of existing and future beneficial water uses; particular emphasis was to be given to the reservation of water for agricultural and municipal needs, as well as guaranteed minimum flows for the protection of existing rights, future uses, water quality, and aquatic life.

The significance of water reservations cannot be overestimated; their impacts will be felt long after the decisions are made. Because of the magnitude of the water reservation requests, the wide variety and magnitude of potential water uses, and their basinwide scope, action on these applications could establish future patterns of water use in the Yellowstone Basin.[5A/]

Federal and Indian Water Rights

Present recognition of Indian "reserved" water rights began with the United States Supreme Court's decision in the Winters case in 1908. The Winters Doctrine, as it has been developed over the years, holds that when the Indian tribes ceded their lands to the United States, reserving smaller tracts for their own use, sufficient water to fulfill their needs on the reservation was also reserved. The measure of the reserved rights is in dispute, although some courts have measured the right according to the irrigable acreage on the reservation. The reserved rights does not depend

5A/ Environmental Impact Statement on Yellowstone Water Reservation.

upon actual use, and is therefore available for future as well as present needs. Thus, even if the quantity of the reserved right is determined, the question arises as to whether that water can be put to uses (such as coal-based industrialization) which were not contemplated when the reservation was created. Since major tributaries of the Yellowstone flow by or through both the Crow and Northern Cheyenne reservations, the Indians' reserved rights will affect other water uses.

Reserved rights attach, not only to Indian lands, but to any lands the United States has withdrawn from the public domain for federal purposes. Upon withdrawing the lands, the United States impliedly withdrew or reserved sufficient water to satisfy the federal purposes. Included in this category are most National Forest lands, national parks, recreation areas, and wildlife refuges. The same problems of quantification seen with Indian rights apply to these federal reserved rights. Further discussion of Indian water rights is found in Chapter IV.

Water Rights Litigation

Aside from the Indian lawsuits (see Chapter IV), another important series of lawsuits concerning water rights in the Yellowstone River Basin involves Intake Water Company, Inc., a wholly-owned subsidiary of Tenneco, Inc., of Houston, Texas. The basis of the three separate actions to which Intake is a party is its claim to an existing right to appropriate 111.4 cfs from the Yellowstone River near Intake, Montana. In the first action, Intake has successfully defended its claim against the state of Montana in district court to a perfected appropriation for sale, rental, and distribution for irrigation, industrial, municipal, and domestic purposes. General plans have been revealed to sell water to "companies with energy generating or conversion plants within or outside the State of Montana," including its parent corporation, Tenneco, Inc. The judgment of the District Court upholding Intake's

claimed appropriation is currently under appeal by the state in the Montana Supreme Court.

A separate action instituted by Intake against the Yellowstone River Compact Commission in Federal District Court seeks a declaratory ruling that Article X of the Yellowstone River Compact is unconstitutional in that it requires unanimous consent of the three signatory states before any water can be diverted from the Yellowstone River Basin. This case is currently stayed, pending a resolution of the issues in the lawsuit mentioned in the preceding paragraph, and none of the issues raised has yet been resolved.

In a third separate action, Intake has sued the DNRC in Montana District Court seeking a declaratory ruling that its planned diversion of 111.4 cfs from the Yellowstone River, for the purposes described above, is not subject to the Montana Major Facility Siting Act. This case is also currently pending.

The outcome of all three of these actions is important because there are several corporations with similar large claims for Yellowstone Basin water for industrial purposes. Furthermore, the action in Federal District Court is the first to interpret and challenge the Yellowstone River Compact. Thus, final resolution of these actions could determined the validity of other claimed rights from the Yellowstone and could significantly affect the future administration of the Yellowstone River Compact.

Another series of lawsuits to which Intake Water Company is a party involves competing water development projects on the Powder River between Intake and Utah International, Inc. The issues raised are complex, but generally involve the question of whether Intake or Utah International has the prior claim to water from the Powder River. The two lawsuits--one in State District Court and the other in Federal District Court--require interpretation of the Yellowstone River Compact and the water appropriation laws of the states of Montana and Wyoming. Both actions are currently pending,

awaiting resolution of preliminary jurisdictional and procedural issues.

Yellowstone River Compact

The Yellowstone River Compact, executed by Montana, Wyoming, and North Dakota, and ratified by the United States Congress in 1950, was designed to allocate water of the Clarks Fork Yellowstone, Bighorn, Tongue, and Powder rivers. The compact recognizes water rights prior to 1950, those rights designated to provide supplemental water supplies to land irrigated prior to 1950, and water rights for irrigation projects started before 1950. The compact divides the remaining water according to percentages of the flow at the mouths of the streams as shown in Table II-2.

Table II-2. Division of Waters Under the Yellowstone River Compact

Stream	Wyoming	Montana
Clarks Fork Yellowstone	60%	40%
Bighorn	80%	20%
Tongue	40%	60%
Powder	42%	58%

Article X of the compact prohibits diversion of water out of the Yellowstone Basin without the unanimous consent of the signatory states. This article has recently become controversial because there are some who would like to divert water out of the basin for energy and other uses. Montana's position at this time is to withhold approval of such diversions until the States can agree on quantification of the percentages of tributary flows. Wyoming has published its estimates of these quantities, as presented in Table II-3. Montana does not necessarily agree and intends to independently calculate its compact share.

Drainage Network

The Yellowstone River originates in Wyoming and flows northeasterly

Table II-3. Wyoming's Yellowstone Compact Estimates (Acre-Feet)

Stream	Wyoming	Montana
Clark Fork Yellowstone	429,000	285,000
Bighorn	1,800,000	400,000
Tongue	96,400	144,700
Powder	120,700	166,600
TOTAL	2,446,100	996,300

Source: Wyoming State Engineer's Office 1973.

through Montana. Its main source of water is the snowpack that accumulates in the mountains during the winter and spring. Surface runoff from this snow normally begins in April and reaches a peak in late May or June. The average monthly flows that occur during the runoff months may be from 5 to 10 times greater than the average flows that occur during the late summer, fall, and winter months.

The mainstem of the Yellowstone River is the only major stream in the United States that is not regulated by a dam and reservoir. Diversion dams have been constructed to provide water for irrigation, but the Yellowstone mainstem is virtually a free flowing stream throughout its 670-mile length.

Because of the free flowing nature of the river, the Yellowstone mainstem has a predominantly braided channel. This channel form, with its islands, bars, and backwaters, sustains many riparian, terrestrial, and aquatic wildlife species.

The Upper Yellowstone Planning Area spans the Yellowstone and its tributaries from the point the river leaves Yellowstone National Park to the confluence of the Yellowstone and Bighorn rivers near Custer, Montana--exclusive of the Clarks Fork and Bighorn rivers. The major tributaries of the Yellowstone are: (1) the Shields River in Park County; (2) the Boulder River in Sweet Grass County; (3) the Stillwater River in Stillwater County; and

(4) Pryor Creek in Yellowstone County.

Shields River

The Shields River drains the northeast section of the Upper Yellowstone River area; principally the eastern slopes of the Bridger Mountains and western slopes of the Crazy Mountains, and the valley between these mountains. The river flows generally southeasterly meeting the Yellowstone River just east of Livingston. Many of the tributaries to the Shields River are perennial, being fed by springs and melting snow from the Bridger and Crazy mountains. Some of the principal tributaries are Potter, Flathead, Cottonwood, Brachett, and Rock creeks.

Boulder River

The Boulder River arises in the Absaroka Mountains just south of the old abandoned mining community of Independence. It flows in a northerly and northeasterly direction, joining the Yellowstone near Big Timber. Many of the tributaries to the Boulder River are perennial, being fed by springs and melting snows in the Absaroka Range. Some of the principal tributaries are Meat Rack Creek, West Boulder River, East Fork of the Boulder River, and East Boulder River.

Stillwater River

The Stillwater River has its headwaters in the mountainous area between the Absaroka and Beartooth ranges. It flows generally northeasterly meeting the Yellowstone near Columbus. Some of the major tributaries of the Stillwater River are West Fork of Stillwater River and East and West Rosebud creeks.

Pryor Creek

Pryor Creek originates at the base of the northern slopes of the Pryor Mountains, from whence it flows northward, meeting the Yellowstone River near Huntley, Montana. The creek has the characteristics of a plains stream in its lower reaches; the high flow period normally occurs earlier in the year

near the mouth than it does further upstream. Peak flows in the upper reaches seem to be dependent on the snow melt from the Pryor Mountains as opposed to the peak flows near the mouth which result from warming trends in late winter and early spring, causing runoff in the lowland plains.

Between Pryor Creek and the Bighorn River, along the mainstem of the Yellowstone, several small streams flow into the river. Creeks to the north of the river have small drainage areas and for the most part are intermittent streams. Geological formations in this segment do not store significant quantities of ground water; consequently, these streams do not have a sustaining ground water flow; flow in these streams is a direct result of snow melt or heavy rains. Two creeks on the south side of the river, Fly and Arrow creeks, are perennial.

Historical and Depleted Flows

Tables II-4 through II-9 illustrate: (1) historical and (2) depleted flows for the 1975 level of development at the U.S. Geological Survey stations at Livingston and Billings, on the Yellowstone River, and at Absarokee on the Stillwater River.[6/] In general, the high flow years were 1943 and the early 1970's for all three of the stations. Low flow years occurred during the late 1930's and during 1960-1961.

The largest portion of the water used in the planning area is for irrigation. Most of the irrigation has been developed privately by individuals and small groups through construction of diversions and small dams. The Bureau of Reclamation developed the Huntley project in the early part of the century; it now includes roughly 24,000 acres of land that lie along the Yellowstone below the Town of Huntley.

6/ Historical flows are the flows that were actually measured at river gaging stations; they are real flows. Depleted flows are historical flows that have been adjusted to reflect some level of development (e.g., the 1975 level of development). Depleted flows illustrate what flows would have been given some level of water consumption development.

Table II-4
Yellowstone River Near Livingston - Historical Flows

UNITS - 1000 AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1938	101.70	83.31	73.79	58.41	49.98	76.86	110.10	354.20	856.30	479.60	231.80	142.80	2618.85
1939	128.40	101.70	82.67	81.56	67.40	87.07	150.00	544.00	503.20	328.40	169.00	110.80	2354.20
1940	101.10	74.32	65.14	55.98	54.64	70.45	93.64	459.90	582.00	259.90	126.20	96.30	2039.57
1941	94.39	76.24	70.81	67.22	60.79	67.46	73.13	332.30	434.00	246.80	162.80	166.90	1852.84
1942	170.40	129.30	108.90	86.35	75.39	80.09	157.20	319.80	702.40	484.00	196.30	121.60	2631.73
1943	98.62	86.84	77.67	69.10	61.51	82.87	199.40	430.60	1107.00	833.90	322.00	177.50	3547.01
1944	127.40	100.40	83.92	73.63	67.85	71.17	77.93	299.20	597.50	396.00	181.20	126.60	2202.80
1945	113.20	92.41	72.48	64.60	52.30	65.03	71.74	260.70	670.60	597.40	276.30	175.70	2512.46
1946	146.10	116.40	91.66	87.51	73.51	88.84	200.20	400.50	641.10	340.50	173.50	122.00	2481.82
1947	113.20	95.66	83.40	65.14	61.85	77.06	96.28	544.00	798.90	560.70	278.00	178.90	2953.09
1948	149.00	114.20	96.67	83.03	77.20	79.50	99.11	545.90	1027.00	441.20	231.50	135.60	3079.91
1949	110.00	91.68	71.90	58.71	55.80	68.62	149.00	580.40	745.20	402.30	205.00	133.80	2672.41
1950	123.90	98.20	71.60	55.00	54.18	56.62	92.61	264.70	883.20	710.40	292.80	183.10	2886.31
1951	163.60	134.80	114.40	84.34	75.77	82.69	123.10	520.00	713.60	591.80	336.90	188.40	3129.40
1952	148.30	112.20	85.86	72.12	68.39	75.91	171.00	632.80	841.30	416.70	224.10	131.50	2980.18
1953	99.89	76.98	70.61	72.65	62.56	69.46	82.73	200.90	741.20	470.90	200.50	123.70	2272.08
1954	99.83	86.68	72.02	60.14	55.44	59.86	92.23	498.50	685.70	571.80	240.20	143.90	2666.30
1955	103.00	87.35	74.30	67.89	56.63	71.03	77.61	239.50	612.70	368.70	200.30	122.00	2081.01
1956	107.00	91.93	84.58	84.87	76.13	85.35	129.90	568.80	1102.00	521.40	231.50	135.60	3219.06
1957	113.90	94.18	79.34	65.95	61.45	78.55	78.13	419.80	900.50	503.30	227.80	142.50	2765.40
1958	117.30	94.31	81.66	66.07	60.40	75.47	79.78	475.40	550.10	263.10	158.00	103.70	2125.29
1959	81.28	82.59	79.50	63.04	48.05	61.74	85.77	235.90	959.60	481.80	204.20	130.60	2514.07
1960	129.00	100.20	89.91	79.16	71.07	91.06	114.10	267.20	633.90	257.70	152.80	101.50	2087.60
1961	93.62	86.06	74.58	64.90	60.31	68.69	69.88	263.00	621.80	231.10	130.60	123.10	1887.64
1962	139.70	118.30	92.83	83.21	85.55	91.10	175.40	510.80	910.80	551.20	262.40	150.90	3172.19
1963	123.40	106.80	95.27	65.30	79.26	77.47	82.81	419.80	861.80	426.20	197.90	139.00	2675.01
1964	113.60	98.26	82.29	64.71	55.25	55.27	84.38	366.10	880.40	642.70	263.90	154.80	2861.66
1965	116.60	100.50	89.71	85.47	73.51	80.99	116.60	363.70	1165.00	797.20	333.50	206.00	3528.78
1966	174.50	128.30	100.90	81.26	66.01	80.61	106.40	421.40	533.90	292.30	157.20	116.40	2259.18
1967	103.30	86.14	76.96	74.28	71.39	81.88	84.40	373.00	1126.00	789.30	283.50	157.50	3307.65
1968	141.40	112.80	92.17	79.70	81.74	92.39	96.00	281.80	1043.00	616.90	326.30	226.50	3190.70
1969	182.80	134.70	105.70	87.37	91.44	97.75	165.40	677.20	709.00	499.20	223.00	133.30	3106.86
1970	122.90	102.80	89.06	79.76	74.84	82.65	81.40	413.00	1093.00	610.80	250.40	179.20	3179.81
1971	146.80	116.40	101.20	90.11	90.82	96.36	110.00	486.00	1217.00	816.10	323.80	197.40	3791.99
1972	162.00	128.30	98.28	87.53	81.34	103.10	117.00	427.10	1189.00	569.50	268.60	204.70	3436.45
1973	191.50	139.60	109.60	99.80	85.90	90.20	87.90	357.80	669.90	356.30	190.90	138.10	2517.50
1974	126.30	111.90	92.37	73.21	67.90	82.24	133.10	380.40	1341.00	745.00	300.00	163.70	3617.12
1975	137.10	103.60	87.15	69.20	63.49	82.75	84.22	205.90	821.80	921.60	315.10	182.00	3073.97
AVG	126.74	102.54	86.08	73.90	67.82	78.58	110.52	403.74	828.22	510.36	232.89	149.15	2770.52

Table II-5
Yellowstone River at Livingston - 1975 Depletion Level

UNITS - 1000AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1938	102.81	84.57	74.74	58.54	50.21	77.09	110.51	351.81	852.66	470.50	226.69	139.99	2600.13
1939	129.51	102.96	83.62	81.79	67.63	87.30	150.41	541.61	499.56	319.30	163.89	107.99	2335.58
1940	102.21	75.58	65.99	56.21	54.87	70.68	94.05	457.41	578.26	250.80	121.09	93.49	2020.65
1941	95.50	77.50	71.66	67.45	61.12	67.69	73.54	329.81	430.26	237.70	157.69	164.09	1834.02
1942	171.51	130.56	109.75	86.60	75.72	80.32	157.61	317.41	698.76	474.90	191.19	118.79	2613.21
1943	99.73	88.10	78.52	69.43	61.84	83.10	199.81	428.21	1103.46	824.80	316.89	174.69	3528.59
1944	128.51	101.66	84.77	73.96	68.28	71.40	78.34	296.81	593.86	386.90	176.09	123.79	2184.38
1945	114.31	93.67	73.33	64.93	52.63	65.16	72.15	258.31	666.96	588.30	271.19	172.89	2493.84
1946	147.21	117.66	92.51	87.64	73.84	88.97	200.61	398.11	637.46	331.40	168.39	119.19	2463.20
1947	114.31	96.92	84.25	65.47	62.28	77.29	96.69	541.61	795.26	551.60	272.89	176.09	2934.67
1948	150.11	115.46	97.52	93.36	77.53	79.73	99.52	543.51	1023.46	432.10	226.39	132.79	3061.49
1949	111.11	92.94	72.75	59.04	56.13	68.85	149.41	578.01	741.56	393.20	199.89	130.99	2653.89
1950	125.01	99.46	72.45	55.33	54.51	56.85	93.02	262.31	879.56	701.30	287.69	180.29	2867.79
1951	164.71	136.06	115.25	84.67	76.10	82.92	123.51	517.61	710.06	582.70	331.79	185.59	3110.98
1952	149.41	113.46	86.71	72.45	68.72	76.14	171.41	630.41	837.66	407.60	218.99	128.69	2961.66
1953	101.00	78.24	71.36	72.90	62.89	69.69	83.14	198.51	737.56	461.80	195.39	120.89	2253.46
1954	100.94	87.94	72.77	60.47	55.67	60.09	92.54	496.11	682.06	562.70	235.09	141.09	2647.58
1955	104.11	88.61	75.05	68.32	56.86	71.16	78.02	237.01	609.06	359.60	195.19	119.19	2062.19
1956	108.11	93.09	85.33	85.30	76.36	85.58	130.21	566.41	1098.46	512.30	226.39	132.79	3200.34
1957	114.51	95.04	79.79	66.16	61.78	78.78	78.44	418.01	897.96	496.70	223.49	139.99	2750.68
1958	117.91	95.17	82.21	66.40	60.73	75.70	80.09	473.61	547.56	256.50	153.69	101.19	2110.77
1959	81.89	83.45	80.05	63.27	48.38	61.87	86.08	234.01	957.06	475.20	199.89	128.09	2499.25
1960	129.61	101.06	90.46	79.49	71.40	91.29	114.41	265.31	631.26	251.10	148.49	98.99	2072.88
1961	94.23	86.92	75.13	65.23	60.64	68.92	70.19	261.11	619.16	224.50	126.29	120.59	1872.92
1962	140.31	119.16	93.28	83.54	85.98	91.33	175.71	508.91	908.16	544.60	258.09	148.39	3157.47
1963	124.01	107.66	95.82	65.63	79.69	77.70	83.12	417.81	859.06	419.60	193.59	136.49	2660.19
1964	114.21	99.12	82.84	65.04	55.58	55.50	84.69	364.11	877.66	636.10	259.59	152.29	2846.74
1965	117.21	101.36	90.26	85.80	73.84	81.22	116.91	361.71	1162.16	790.60	329.19	203.49	3513.76
1966	174.61	128.76	101.25	81.49	66.34	80.84	106.61	420.01	532.06	288.20	153.59	114.19	2247.96
1967	103.41	86.60	77.31	74.51	71.72	82.11	84.61	371.51	1124.16	785.20	279.89	155.29	3296.33
1968	141.51	113.26	92.52	79.93	81.97	92.62	96.21	280.31	1041.16	612.70	322.69	224.29	3179.18
1969	182.91	135.16	104.05	87.60	91.67	97.98	165.51	675.71	707.16	495.00	219.39	131.09	3095.24
1970	123.01	103.26	89.41	79.99	75.07	82.78	81.51	411.41	1091.06	606.60	246.79	176.99	3167.89
1971	146.91	116.86	101.55	90.34	91.05	96.59	110.11	484.41	1215.06	811.90	320.19	195.19	3780.17
1972	162.09	128.67	98.56	87.72	81.53	103.28	117.09	425.83	1187.45	566.14	265.71	202.93	3426.98
1973	191.57	139.88	109.81	99.94	86.04	90.34	87.97	356.84	668.73	353.78	188.73	136.77	2510.38
1974	126.34	112.08	92.51	73.30	67.99	82.33	133.14	379.76	1340.22	743.31	298.55	162.81	3612.36
1975	137.12	103.69	87.22	69.31	63.54	82.79	84.24	205.58	821.40	920.75	314.37	181.55	3071.56
AVG	127.46	103.47	86.69	74.18	68.11	78.79	110.82	401.76	825.38	503.37	228.55	146.68	2755.27

Table II-6
Stillwater River Near Absaroka - Historical Flows

UNITS - 1000 AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1936	17.99	13.51	11.64	8.93	5.93	9.98	17.28	77.61	113.60	38.47	30.97	22.23	368.14
1937	16.61	13.77	11.34	7.16	11.31	18.96	13.81	86.57	211.60	107.80	29.36	17.26	545.55
1938	21.85	15.29	14.79	12.40	13.32	13.89	17.98	74.59	208.40	129.80	40.05	24.87	587.29
1939	25.17	25.54	19.48	19.61	11.79	17.22	20.04	97.90	93.12	63.48	27.24	16.35	436.94
1940	17.88	14.72	11.88	13.20	12.33	11.24	18.10	102.70	205.80	73.96	26.53	25.18	533.52
1941	27.23	18.33	15.94	18.70	11.39	13.35	16.81	87.93	170.70	92.65	53.79	65.40	592.22
1942	52.37	29.99	24.98	25.36	15.30	15.96	30.70	103.20	210.30	204.00	51.77	30.84	794.79
1943	32.07	25.60	22.36	19.59	18.59	28.70	70.52	110.20	291.10	274.30	83.18	52.92	1029.13
1944	35.06	25.54	20.66	13.59	10.23	15.99	18.30	106.20	282.00	223.30	62.14	45.74	858.75
1945	32.97	25.51	20.65	18.34	15.07	18.34	23.03	61.76	213.10	228.20	75.18	43.71	775.86
1946	30.39	25.09	19.72	19.02	15.39	19.82	29.59	61.63	173.99	118.80	40.91	33.25	587.51
1947	31.61	23.71	20.38	19.62	15.18	25.30	34.41	126.90	187.00	195.30	63.57	44.86	787.84
1948	42.73	27.24	21.52	17.31	17.74	21.34	26.48	120.80	275.70	134.00	66.63	29.04	800.53
1949	25.62	21.72	18.62	15.31	10.50	16.30	27.92	114.60	173.30	99.78	39.04	33.58	596.29
1950	29.05	21.66	16.40	11.29	13.84	16.96	20.05	53.02	209.00	190.60	64.15	45.98	692.00
1951	38.05	29.66	23.19	20.63	18.37	20.09	25.91	96.83	139.20	181.90	85.83	39.16	719.02
1952	34.35	25.08	18.85	16.17	14.34	17.73	40.44	139.30	226.50	138.00	72.94	35.71	779.41
1953	24.55	22.05	19.29	17.57	15.07	15.51	19.69	47.22	181.50	139.60	56.92	29.19	588.16
1954	20.74	20.44	18.07	13.76	15.68	18.16	20.04	98.80	126.90	159.60	45.67	24.33	582.21
1955	25.84	22.36	15.87	12.85	12.02	12.79	21.75	48.42	150.40	100.10	37.70	22.30	482.40
1956	22.67	18.23	18.93	17.71	14.44	22.23	26.20	141.60	234.40	109.60	54.35	28.62	708.98
1957	23.61	21.89	22.76	13.35	12.08	14.34	19.39	140.90	343.70	229.90	59.40	41.48	942.80
1958	32.54	28.61	23.99	19.87	16.38	16.39	19.46	148.10	172.60	88.58	52.56	33.15	652.25
1959	25.05	24.03	22.52	18.55	15.03	19.52	24.19	57.87	268.10	131.40	44.98	27.06	678.30
1960	31.60	27.79	21.73	18.23	13.00	13.63	13.44	40.61	150.00	59.33	33.99	19.07	442.42
1961	21.20	19.61	17.61	15.06	14.18	12.73	8.57	56.55	150.40	49.34	28.99	45.50	439.76
1962	41.19	32.22	26.44	20.71	22.25	19.15	33.49	75.97	237.60	155.40	72.49	46.22	783.13
1963	37.27	24.65	20.82	18.32	19.78	15.05	20.26	101.00	267.30	122.20	44.94	41.45	733.04
1964	29.32	23.61	17.64	16.34	14.85	14.49	17.92	70.60	203.90	178.20	43.74	23.93	654.54
1965	20.36	23.13	22.68	20.26	18.53	16.37	25.14	59.17	246.40	207.90	79.42	48.87	788.23
1966	39.10	25.63	21.27	18.46	16.64	18.32	27.49	105.20	138.20	89.25	43.66	29.70	572.92
1967	31.45	22.53	18.96	19.60	15.18	20.96	15.80	73.54	325.60	272.80	64.10	41.34	921.86
1968	47.74	29.47	19.28	19.76	19.18	26.99	21.10	54.17	250.80	169.50	87.69	53.71	799.39
1969	39.89	25.50	21.07	19.89	18.43	18.39	25.56	97.34	172.90	160.70	51.14	25.95	676.76
1970	26.73	23.83	18.37	14.29	14.47	13.41	18.71	120.80	333.30	160.10	50.79	52.73	847.53
1971	35.77	26.09	22.67	22.90	21.54	17.84	27.84	95.10	282.50	188.00	71.37	64.00	875.62
1972	45.05	31.74	22.93	18.87	25.85	34.01	25.12	85.34	238.80	127.90	88.94	63.86	808.41
1973	43.88	29.28	22.88	17.59	16.36	18.22	39.21	113.30	207.90	131.30	47.74	54.34	742.00
1974	33.38	24.91	21.16	20.10	16.03	19.99	28.95	63.78	342.90	226.20	75.19	42.93	915.52
1975	33.29	26.37	17.57	16.05	11.77	18.37	36.34	118.30	271.70	391.60	86.37	35.39	1063.12
AVG	31.08	23.90	19.67	17.17	15.23	17.95	24.68	90.89	217.05	153.57	55.89	37.53	704.60

Table II-7
Stillwater River Near Absaroka - 1975 Depletion Level

UNITS - 1000AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1936	18.11	13.87	11.89	8.96	5.85	9.80	17.49	76.63	112.20	35.81	29.98	21.55	362.13
1937	16.73	14.13	11.59	7.29	11.23	18.78	13.32	85.59	210.30	105.14	28.37	16.68	539.14
1938	22.07	15.65	15.04	12.59	13.24	13.71	18.19	73.61	207.10	127.14	39.06	24.29	581.68
1939	25.39	25.80	19.73	19.64	11.71	17.04	20.15	96.92	91.72	60.82	26.15	15.77	430.83
1940	18.10	14.98	12.13	13.23	12.25	11.06	18.21	101.72	204.50	71.30	25.44	24.60	527.51
1941	27.45	18.59	16.09	18.73	11.31	13.17	16.92	86.95	169.40	89.99	52.70	64.82	586.11
1942	52.69	30.25	25.23	25.51	15.22	15.68	30.81	102.22	209.00	201.34	50.68	30.26	788.88
1943	32.39	25.86	22.61	19.62	18.51	28.62	70.63	109.22	289.80	271.64	82.09	52.34	1023.32
1944	35.38	25.80	20.91	13.62	10.15	15.91	18.41	105.22	280.70	220.54	60.95	45.16	852.74
1945	33.29	25.77	20.90	18.27	15.09	18.16	23.14	60.78	211.80	225.54	74.09	43.13	769.95
1946	30.71	25.35	19.87	18.95	15.41	19.64	29.70	60.55	172.60	116.14	39.82	32.77	581.50
1947	31.93	23.97	20.53	19.55	15.20	25.12	34.52	125.82	185.70	192.64	62.48	44.38	781.83
1948	43.05	27.50	21.67	17.24	17.66	21.16	26.59	119.72	274.40	131.34	65.44	28.46	794.22
1949	25.94	21.98	18.77	15.24	10.42	16.12	28.03	113.52	172.00	97.12	37.85	33.10	590.08
1950	29.37	22.02	16.55	11.22	13.76	16.78	20.16	51.94	207.70	187.94	63.06	45.50	685.99
1951	38.37	30.02	23.34	20.76	18.39	19.91	26.02	95.75	137.90	179.24	84.64	38.68	713.01
1952	34.67	25.44	19.00	16.20	14.26	17.55	40.55	138.22	225.20	135.34	71.75	35.23	773.40
1953	24.97	22.31	19.44	17.60	15.09	15.33	19.80	46.14	180.20	136.94	55.73	28.71	582.25
1954	21.36	20.70	18.22	13.81	15.70	18.08	20.15	97.72	125.60	156.94	44.48	23.85	576.60
1955	26.16	22.72	16.02	12.86	12.04	12.71	21.86	47.34	149.00	97.44	36.51	21.82	476.49
1956	23.09	18.49	18.98	17.64	14.46	22.15	26.31	140.52	233.10	106.94	53.26	28.14	703.07
1957	24.03	22.15	22.91	13.36	12.20	14.26	19.50	139.82	342.40	227.24	58.21	41.00	937.09
1958	32.96	28.87	24.14	19.92	16.50	16.31	19.57	147.02	171.30	85.92	51.37	32.57	646.44
1959	25.57	24.29	22.67	18.58	15.15	19.44	24.30	56.79	266.80	128.74	43.79	26.58	672.69
1960	32.02	28.05	21.88	18.16	13.12	13.55	13.45	39.53	148.70	56.67	32.80	18.49	436.41
1961	21.62	19.87	17.76	15.11	14.30	12.65	8.68	55.57	149.10	46.68	27.80	45.02	434.15
1962	41.61	32.48	26.59	20.74	22.37	19.07	33.60	74.99	236.30	152.74	71.30	45.74	777.52
1963	37.69	25.01	20.97	18.35	19.90	14.97	20.37	100.02	266.00	119.54	43.65	41.07	727.53
1964	29.64	23.87	17.89	16.37	14.97	14.51	17.93	69.62	202.60	175.54	42.45	23.45	648.83
1965	20.78	23.39	22.93	20.39	18.55	16.39	25.15	58.19	245.10	205.24	78.13	48.49	782.72
1966	39.12	25.59	21.32	18.49	16.56	18.24	27.50	104.82	137.80	88.69	43.17	29.52	570.81
1967	31.47	22.49	19.01	19.63	15.20	20.98	15.81	73.16	325.20	272.34	63.61	41.16	920.05
1968	47.66	29.53	19.33	19.79	19.20	27.01	21.11	53.89	250.40	169.04	87.20	53.53	797.68
1969	39.81	25.56	21.12	19.92	18.35	18.41	25.57	96.96	172.50	160.24	50.65	25.87	674.95
1970	26.65	23.89	18.42	14.32	14.49	13.43	18.62	120.42	332.90	159.64	50.40	52.55	845.72
1971	35.69	26.15	22.72	22.93	21.56	17.86	27.75	94.72	282.10	187.54	70.98	63.82	873.81
1972	44.99	31.79	22.97	18.89	25.86	34.02	25.05	85.04	238.48	127.53	88.63	63.71	806.95
1973	43.63	29.32	22.91	17.61	16.37	18.23	39.15	113.07	207.66	131.02	47.51	54.23	740.89
1974	33.35	24.94	21.18	20.11	16.04	20.00	28.91	63.62	342.73	226.01	75.03	42.86	914.77
1975	33.27	26.38	17.58	16.06	11.77	18.37	36.32	118.22	271.61	391.50	86.29	35.35	1062.73
AVG	31.33	24.12	19.82	17.18	15.23	17.85	24.73	90.04	215.99	151.48	54.94	37.10	699.81

Table II-8
Yellowstone River at Billings - Historical Flows

UNITS - 1000 AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1929	296.00	248.00	207.00	180.00	153.00	263.00	247.00	594.00	1320.00	842.00	288.00	224.00	4862.00
1930	208.00	157.00	123.00	135.00	194.00	184.00	316.00	539.00	916.00	504.00	413.00	245.00	3944.00
1931	292.00	176.00	141.00	148.00	141.00	152.00	172.00	448.00	958.00	232.00	173.00	150.00	3183.00
1932	187.00	136.00	136.00	115.00	89.70	213.00	159.00	719.00	1500.00	812.00	251.00	195.00	4512.70
1933	196.00	176.00	97.20	93.50	91.60	160.00	173.00	478.00	1560.00	465.00	234.00	239.00	3963.30
1934	181.00	187.20	153.70	164.50	130.30	153.00	280.00	633.00	586.10	209.70	104.80	111.80	2915.10
1935	154.70	139.50	126.70	129.80	136.00	125.60	154.40	431.80	1327.00	765.80	233.90	155.70	3880.90
1936	152.60	179.30	140.60	141.90	120.90	151.90	291.90	944.80	1097.00	358.50	240.80	163.10	3983.30
1937	174.60	163.40	121.40	113.90	104.40	181.80	156.40	637.80	1205.00	518.30	163.90	130.30	3671.20
1938	195.50	159.30	117.50	178.40	106.50	160.00	172.20	659.80	1764.00	930.50	301.40	200.40	4945.50
1939	218.50	214.90	160.20	133.20	101.80	212.30	258.10	869.60	971.10	489.00	195.40	138.70	3962.80
1940	167.10	146.10	129.00	83.80	103.90	135.50	172.70	727.90	1136.00	356.80	114.90	128.60	3402.30
1941	203.60	156.30	131.10	115.20	111.30	128.80	161.90	575.10	929.50	390.20	237.50	405.70	3546.20
1942	418.30	279.90	217.20	179.10	149.20	241.90	351.70	811.50	1480.00	911.20	280.60	216.70	5537.30
1943	228.50	223.40	202.80	159.10	222.00	329.40	523.60	806.80	2214.00	1653.00	507.60	325.60	7395.80
1944	245.70	223.60	188.10	161.30	138.80	177.40	148.40	533.80	1725.00	1049.00	279.40	259.80	5130.30
1945	229.30	203.70	139.80	157.90	125.60	165.00	160.10	477.00	1503.00	1251.00	417.70	270.20	5100.30
1946	259.20	235.60	165.50	197.40	166.40	196.20	331.70	653.40	1254.00	644.40	223.80	225.30	4572.90
1947	267.90	210.00	176.90	160.10	125.30	193.70	275.20	1060.00	1508.00	1028.00	402.30	284.10	5692.50
1948	296.20	235.90	201.80	162.50	155.00	198.50	235.10	1053.00	2160.00	782.50	336.10	189.80	6006.40
1949	205.00	185.20	131.40	118.40	131.60	181.10	291.20	962.20	1347.00	590.90	221.50	219.30	4584.80
1950	240.90	201.70	121.00	87.10	115.50	193.00	208.50	547.10	1657.00	1339.00	481.10	304.20	5496.10
1951	328.20	288.40	246.40	172.10	147.20	230.70	272.20	914.20	1248.00	1122.00	594.70	318.10	5932.20
1952	313.40	263.70	181.20	162.00	156.80	186.10	409.50	1251.00	1629.00	756.90	374.40	221.40	5905.40
1953	188.50	174.80	163.40	170.70	139.50	148.80	166.90	346.50	1482.00	858.10	324.00	189.80	4353.00
1954	169.70	185.90	170.10	120.70	149.00	138.50	199.40	863.40	1097.00	969.30	320.20	192.20	4575.40
1955	186.60	183.90	156.70	133.30	113.40	142.20	236.90	470.10	1209.00	633.20	248.40	160.40	3874.10
1956	184.20	166.10	169.60	159.60	144.30	249.40	310.30	1227.00	1928.00	760.00	341.70	221.00	5861.20
1957	187.90	207.50	174.50	99.70	141.90	185.90	187.50	978.40	2258.00	1097.00	327.50	284.60	6130.40
1958	261.10	232.30	191.10	151.60	133.70	158.00	181.10	971.60	1154.00	481.10	235.40	175.90	4326.90
1959	166.90	194.70	174.30	139.80	123.80	177.80	216.10	516.90	1965.00	909.70	281.50	204.80	5071.30
1960	267.80	228.50	191.40	117.50	138.20	177.40	210.10	415.40	1186.00	364.30	209.60	140.40	3646.60
1961	163.30	179.00	149.10	134.80	132.20	124.00	85.60	437.20	1129.00	305.60	137.20	285.00	3262.00
1962	307.40	270.20	193.40	144.60	220.60	213.70	359.40	819.80	1743.00	931.40	420.80	302.90	5927.20
1963	246.60	213.60	184.60	132.10	227.60	162.40	183.30	792.40	1805.00	701.30	246.90	247.20	5143.00
1964	199.40	198.30	151.70	144.80	151.30	148.30	202.40	716.50	1729.00	1166.00	357.20	229.20	5394.10
1965	188.60	202.40	184.40	208.90	184.40	172.60	306.20	698.10	2098.00	1481.00	579.50	409.90	6714.00
1966	356.40	254.10	199.10	180.60	170.80	202.40	236.90	820.80	976.90	480.90	221.10	201.80	4301.80
1967	213.60	215.00	191.20	189.50	163.50	195.60	186.20	689.10	2453.00	1614.00	411.60	248.30	6770.60
1968	300.90	248.80	195.10	164.20	221.70	226.40	220.60	481.20	2040.00	1147.00	578.10	434.40	6258.40
1969	341.40	273.90	200.20	178.20	179.40	224.90	363.00	979.80	1333.00	956.40	293.70	203.90	5527.80
1970	252.80	224.20	188.50	155.80	159.20	166.70	183.60	1021.00	2182.00	1035.00	340.10	349.00	6257.90
1971	302.90	237.90	189.70	189.20	226.40	195.30	284.30	905.50	2224.00	1312.00	468.70	397.40	6933.30
1972	349.60	269.50	200.90	162.20	198.40	300.80	235.30	723.70	1964.00	884.00	486.30	398.30	6173.00
1973	391.30	284.90	200.80	192.20	171.10	201.30	291.10	862.30	1260.70	652.00	255.40	326.90	5090.00
1974	265.50	243.50	199.50	190.90	147.20	178.40	276.00	619.60	2441.00	1328.00	495.90	301.80	6687.30
1975	257.70	245.60	181.90	150.30	123.50	213.80	307.20	913.60	1957.00	2286.00	556.10	296.90	7489.60
AVG	242.75	211.38	169.31	150.65	150.00	187.63	241.51	736.12	1544.88	858.62	323.57	245.19	5061.60

Table II-9
Yellowstone River at Billings - 1975 Depletion Level

UNITS - 1000AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1929	299.79	252.65	209.98	181.52	153.93	263.51	245.41	580.63	1301.96	804.65	269.74	214.80	4778.55
1930	211.79	171.65	125.98	136.52	194.93	184.51	314.41	525.43	897.76	466.65	394.74	235.80	3860.15
1931	295.79	180.65	143.98	149.52	141.93	152.51	170.41	434.43	939.76	194.65	154.74	140.80	3099.15
1932	190.79	140.65	138.98	116.52	90.63	213.51	157.41	705.53	1481.86	774.65	232.74	185.80	4429.05
1933	199.79	180.65	100.18	95.02	92.53	160.51	171.41	464.53	1541.86	427.65	215.74	229.80	3879.65
1934	184.79	191.85	156.68	186.02	131.23	153.51	278.41	619.43	567.86	172.35	86.54	102.60	2831.25
1935	158.49	144.15	129.68	131.32	136.93	126.11	152.81	418.43	1308.86	728.45	215.64	146.50	3797.35
1936	156.39	183.95	143.58	143.42	121.83	152.41	290.31	931.43	1078.86	321.15	222.54	153.90	3899.75
1937	178.39	168.05	124.38	115.42	105.33	182.31	154.81	524.43	1186.96	480.95	145.64	121.10	3587.75
1938	199.29	163.95	120.48	179.92	107.43	160.51	170.61	646.43	1745.96	893.15	283.14	191.20	4862.05
1939	222.29	219.55	163.18	134.72	102.73	212.81	255.91	855.33	952.06	451.05	177.14	129.50	3876.25
1940	170.89	150.75	131.98	85.32	104.83	136.01	170.61	713.53	1117.06	318.85	96.64	119.40	3315.85
1941	207.39	160.95	134.08	116.72	112.23	129.31	160.01	561.03	910.76	352.45	219.24	396.50	3460.65
1942	422.09	284.55	220.18	180.62	150.13	242.41	350.61	798.83	1462.66	874.25	262.34	207.50	5456.15
1943	232.29	228.05	205.78	160.62	222.93	329.91	522.61	794.13	2196.86	1616.15	489.34	316.40	7315.05
1944	249.49	228.25	151.08	162.82	139.73	177.91	147.31	521.13	1707.66	1012.05	261.14	250.60	5049.15
1945	233.09	208.15	142.78	159.42	126.53	165.51	158.71	463.93	1485.26	1213.85	399.44	261.00	5017.65
1946	262.99	240.15	168.58	198.72	187.33	196.71	330.41	640.33	1236.26	607.25	205.44	216.10	4490.25
1947	271.69	214.65	179.98	161.52	127.23	194.21	273.91	1047.03	1490.36	990.95	384.04	274.90	5610.45
1948	299.99	240.45	204.88	164.02	155.93	199.01	234.01	1040.13	2142.66	745.45	317.94	180.60	5925.05
1949	208.79	189.75	134.48	119.82	132.53	181.61	290.11	949.43	1329.66	553.95	203.24	210.10	4503.45
1950	244.69	206.25	124.18	88.52	116.43	193.51	207.31	534.43	1639.56	1302.15	462.84	295.00	5414.85
1951	331.99	292.95	249.58	173.52	198.13	231.21	271.11	901.73	1230.86	1085.15	576.34	308.90	5851.45
1952	317.19	268.25	184.18	153.42	157.73	186.71	408.71	1238.83	1612.05	720.25	355.94	212.20	5825.45
1953	192.29	179.35	166.38	172.22	140.43	149.41	165.91	334.13	1464.86	821.35	305.54	180.60	4272.45
1954	173.49	190.45	173.18	122.12	149.93	139.11	198.71	851.13	1080.06	932.75	301.94	182.90	4495.75
1955	189.59	187.85	159.38	134.42	114.23	142.71	236.41	458.83	1193.66	600.65	231.44	151.70	3800.85
1956	187.19	170.05	172.28	160.82	145.13	249.81	309.71	1216.03	1912.96	727.45	324.54	212.40	5788.35
1957	190.39	211.05	176.98	100.82	142.73	185.41	187.11	968.43	2244.46	1067.25	311.14	276.10	6062.85
1958	263.59	235.85	193.48	152.72	134.53	158.51	180.31	961.43	1140.25	451.05	219.14	167.50	4258.35
1959	169.39	198.25	176.68	141.02	124.63	174.31	215.41	506.63	1951.26	879.75	265.34	196.40	5003.05
1960	269.49	231.35	193.48	118.52	138.93	177.91	209.31	406.03	1173.66	338.25	194.64	132.50	3584.05
1961	164.99	181.85	151.18	135.72	132.93	124.51	85.11	427.83	1116.66	279.85	122.14	277.10	3199.85
1962	309.09	273.25	195.48	145.52	221.33	214.11	358.91	810.43	1730.66	905.55	405.94	294.80	5865.05
1963	248.29	216.65	186.58	133.02	228.43	162.81	182.81	783.03	1792.66	675.55	231.84	239.30	5080.95
1964	199.89	200.35	153.18	145.62	152.13	148.91	202.01	709.23	1719.66	1147.35	344.54	222.20	5345.05
1965	189.19	204.55	185.98	209.62	185.13	173.21	305.81	690.93	2088.76	1462.25	566.84	402.90	6665.15
1966	356.09	255.55	200.28	181.22	171.43	202.91	236.41	815.03	969.56	467.05	209.94	195.30	4260.75
1967	213.29	216.35	192.48	190.22	164.13	196.21	185.91	682.93	2445.76	1600.15	400.44	241.80	6729.65
1968	300.59	250.15	196.38	154.82	222.33	227.11	220.21	475.03	2032.86	1133.15	567.04	427.90	6217.55
1969	341.29	275.25	201.38	178.82	180.03	225.51	362.71	973.83	1325.76	942.65	282.74	197.50	5487.45
1970	252.69	225.65	189.68	156.42	159.83	167.31	183.41	1014.93	2174.96	1021.45	329.14	342.60	6218.05
1971	302.69	239.35	190.78	189.92	227.03	195.91	284.01	899.43	2216.96	1298.35	457.74	391.00	6893.15
1972	349.43	270.66	201.76	162.77	198.91	301.29	235.07	718.84	1958.36	872.91	477.52	393.17	6140.67
1973	391.17	285.77	201.45	192.63	171.48	201.67	290.92	858.64	1256.45	643.47	248.80	323.05	5065.51
1974	265.41	244.06	199.93	191.19	147.45	178.64	275.88	617.15	2438.16	1322.03	491.49	299.23	6670.65
1975	257.65	245.89	182.12	150.44	123.63	213.92	307.14	912.37	1955.55	2282.59	553.88	295.61	7480.79
AVG	245.26	214.90	171.68	151.82	150.81	188.14	240.56	725.59	1530.84	829.38	308.00	237.12	4994.09

Mainstem cities (Billings, Laurel, Livingston, and Gardiner) utilize water for domestic, municipal, and industrial purposes due to its availability and good quality.

There are three reservoirs in the area that have a capacity of more than 5,000 acre-feet: (1) Mystic Lake--West Rosebud Creek; (2) Lake Adam--Sweet Grass Creek; and (3) Lake Walvoord--Sweet Grass Creek.

The Montana Power Company's 10-megawatt plant at Mystic Lake on West Rosebud Creek is the largest hydroelectric generating facility in the planning area.

Surface Water Quality[7/]

Yellowstone Mainstem: Yellowstone Park to Livingston

The Yellowstone mainstem from the State boundary to Livingston has relatively low concentrations of dissolved solids, with a calcium-sodium-bicarbonate-type of water. Sulfate is a secondary anion with concentrations generally slightly greater than those of calcium and sodium. Potassium, magnesium, and chloride are minor constituents of this water. Dissolved solid concentrations in this reach of the Yellowstone River are consistently less than 220 mg/l. The downstream increase in dissolved solids can be primarily accounted for by calcium and bicarbonate, which tend to increase downstream through this reach of the Yellowstone River, while sodium and sulfate values tend to remain constant. The increases are due to the predominantly calcium-bicarbonate characteristics of tributary streams.

Fluoride was also found to be a minor constituent of the river water in

7/ Information found in this section has been taken from one or more of the Water Quality Inventory and Management Plans by the Water Quality Bureau of the Montana Department of Health and Environmental Sciences. Additional information regarding point and nonpoint sources of pollution are also available in these publications or may be found in the "208" Mid-Yellowstone Water Quality Plan of the Mid-Yellowstone Areawide Planning Organization that will be available in the spring of 1978.

this reach, but concentrations were consistently higher than those in most of the tributary streams and higher than concentrations in water from downstream sites on the river. This is probably a reflection of thermal discharges into the upstream reaches of the river in Yellowstone National Park (e.g., from geyser activity). High fluoride concentrations are typical of thermal discharges in the Park.

Temperatures vary with season in this reach of the Yellowstone River and range from 0.0°C in the winter to near 18.0°C during the summer. This range is typical of a cold-water trout habitat and is also observed in smaller streams in the region.

Shields River

The water of the Shields River can be classified as non-saline, while generally ranging from moderately hard to hard. Along with total hardness, dissolved solid concentrations in the Shields River are slightly higher than those in the Yellowstone River. This, coupled with generally higher suspended sediment, turbidity, and specific conductive values would indicate that the quality of water in the Shields is somewhat inferior to that of the mainstem Yellowstone River. In addition, the concentrations of metals, particularly iron, manganese, and zinc, were found to be higher in this tributary stream.

Boulder River

The water in the Boulder is generally of better quality than that of the Yellowstone River mainstem. Along with the Shields and Stillwater rivers, the Boulder River is unique in the Yellowstone area in having all of its drainage area in Montana.

The Boulder River has a soft, calcium-bicarbonate-type of water. Its waters are non-saline and carry only a very low concentration of metals. Sulfate is apparently the major secondary ion in the water, but in concentrations commonly less than 10 mg/l. These characteristics and its range of

temperatures (0.0 to 14°C) and pH (7.0 to 8.0) along with high dissolved oxygen concentrations are indicative of an excellent, cold-water fishery.

Stillwater River

Surface waters in the Stillwater River drainage have a composition similar to that of the Boulder River. Streams are of a calcium-bicarbonate composition, with bicarbonate the most prevalent component, and sodium, potassium, chloride, and fluoride as minor constituents. Magnesium concentrations commonly are greater or closely equivalent to those of sodium (under mass, rather than equivalent considerations). Sulfate concentrations were found to be similar depending upon the stream and reach.

Waters of this system have low dissolved solid concentrations and are non-saline. However, in the downstream reaches and in some smaller creeks (such as Silver, Little Rocky, and Initial creeks) dissolved solids approached and occasionally exceeded 200 mg/l. Most typically, dissolved solids range from 30 to 150 mg/l. The Rosebud creeks are distinct in their soft waters and low dissolved solids and probably possess the highest quality of water of this river system.

These streams exhibit a wide range of pH which varies from 6.5 to 8.5 and is naturally occuring. Temperatures range from 0°C in the winter to 8-18°C in the summer, which is typical of cold-water habitats. Dissolved oxygen was found to be near saturation in all cases (much greater than 5 mg/l) varying as a function of temperature and altitude rather than a function of organic loading.

Yellowstone Mainstem: Livingston to Huntley

One major change in the Yellowstone River from Livingston to Huntley is a general increase in the maximum summer temperatures of the stream. This is correlated with the general change of the river from a cold-water fishery upstream to a warm-water fishery in its lower reaches. The primary

change in the water quality is a downstream increase in dissolved constituents. However, the overall quality of water remains quite good.

Of importance, in a cumulative sense, are the small, mostly intermittent tributaries that enter the Yellowstone in this reach. The chemical composition of these streams differs from the Yellowstone River and tends to approach a sodium-sulfate-type water with calcium and bicarbonate present as important components.

Pryor Creek

Information gathered by the State Water Quality Bureau appears to indicate that from time to time, Pryor Creek has a significant degrading effect on the Yellowstone River stemming from loadings of sediment and total dissolved solids. The water quality of Pryor Creek, itself, ranges from good in the upper reaches to poor in the lowest reaches. Concentrations of sodium, sulfate, chloride, and total suspended sediments increase significantly for Pryor Creek in its lower reaches.

Ground Waters[8/]

The Upper Yellowstone area contains highly diversified geologic conditions. Between the Bighorn River and Big Timber, the strata are generally flat-lying or gentle folded and contain common sedimentary rock types. Above Big Timber, the strata tends to be highly folded and contains considerable igneous and water-laid volcanic material. Important aquifers occur in Paleozoic, Mesozoic, Tertiary, and Quaternary deposits of the area.

The Paleozoic strata contain several massive carbonate units that yield large amounts of good quality water. Below Big Timber, the Madison Group, for example, yields several hundred gallons per minute of water containing about 3,000 milligrams per liter dissolved solids. Above Big Timber, the

8/ The technical parts of this section were prepared by Rickard Hutchinson of the U.S. Geological Survey, Billings, Montana.

Madison and other carbonate rocks should be capable of yielding more water and of better quality because of the relative closeness of recharge areas along mountain fronts.

Mesozoic sandstones below Big Timber yield as much as several hundred gallons per minute to wells. The water generally contains between 200 and 8,000 milligrams per liter dissolved solids. Above Big Timber, the Mesozoic sandstones are dominated by the 10,000-foot thick Livingston Group. These rocks are generally capable of yielding as much as a few hundred gallons per minute. Dissolved solids of shallow wells in the Livingston Group averages about 250 milligrams per liter.

The Tertiary Fort Union Formation is widely used as a source of water below Big Timber. The strata contains some massive sandstone units that can yield as much as 50 gallons per minute to wells. Dissolved solids usually range from about 280 to 1,500 milligrams per liter.

Quaternary alluvial and terrace deposits along the Yellowstone River and major tributaries are locally capable of yielding as much as 1,000 gallons per minute to wells. Water quality ranges from about 400 to 6,000 milligrams per liter. Water logging of land because of high water-table conditions in these deposits is known to be a problem in the Billings area.

Ground water is widely used in the Upper Yellowstone area in domestic, municipal, and livestock consumption and to a lesser extent for irrigation. Ground water is widely available in the basin and appears generally of good quality.

Pollution of ground water has occurred in a number of areas in the Upper Yellowstone River area. Petroleum products have polluted ground water in scattered areas in the vicinity of Livingston, Laurel, and Billings, and Billings Heights. Contamination of ground water in these areas is caused by phenolic compounds, oil, and other petroleum products. Industrial stockpiling

of chromate ores in the vicinity of Columbus has resulted in the pollution of a groundwater zone adjacent to the Yellowstone River near Columbus. In the upper portion of the Stillwater River drainage, there is pollution of surface water due to seepage of acid mine waters from underground workings and from areas disturbed by mining.

Septic tanks and subsurface disposal systems can create localized areas of ground water pollution. Where there are large numbers of septic tanks and individual water supplies using wells, ground water pollution can occur if these facilities are improperly designed and located. Such problems have tentatively been identified in the Livingston area and in the Billing Heights area and are being investigated.[9/]

9/ Interim Report of the Mid-Yellowstone Areawide "208" Planning Organization, October, 1976.

CHAPTER III

SOCIOECONOMIC CHARACTERISTICS

Population

Population Estimates

Yellowstone County alone accounts for more than 80 percent of the area's population. The surrounding counties (Park, Stillwater, and Sweet Grass) are rural and sparsely populated. Table III-1 illustrates the influence of Yellowstone County on the planning area; while the rural counties experienced outmigration in the 1960's, Yellowstone County grew by almost 11 percent, causing the planning area as a whole to show a 5.2 percent increase in population.

In the first five years of this decade (1970-1975), all of the counties in the planning area had begun to recover the population losses that occurred during the previous decade. The area's population increased by about 11 percent in only five years. It appears that the population increases during this period can be attributed to inmigration based on favorable economic conditions stemming from favorable agricultural, energy and manufacturing developments throughout Eastern Montana.

Racial Characteristics

The racial composition of the area is almost entirely white; the only significant non-white population in the area is approximately 1,000 Indians that reside in Yellowstone County. Table III-2 displays the racial composition of the area. The outlying rural counties are almost entirely without minority populations.

Table III-1. Population Estimates for
Upper Yellowstone, Montana

County	1960 1/	1970 1/	1975 2/	Percent Change	
				1960-70	1970-75
Park	13,168	11,261	12,000	-14.5	+6.6
Stillwater	5,526	4,632	5,300	-16.2	+14.4
Sweetgrass	3,290	2,980	3,000	-9.4	+0.8
Yellowstone	79,016	87,367	97,400	+10.5	+11.5
Total	101,000	106,240	117,700	+5.2	+10.8
State	674,767	694,409	748,000	+2.9	+7.7
% of State	15.0	15.3	15.7	-	-

1/ U.S. Bureau of Census, 1970 Census of Population.
2/ U.S. Bureau of Census, Estimates of the Population of Montana Counties and Metropolitan Areas, July 1, 1974 and 1975, Series P-26, No. 75-26, June 1976.

Table III-2. County Population Classified by Race, Upper Yellowstone, Montana: 1960 and 1970 1/

County	Year	White		Indian		Other Nonwhite	
		Number	% of Total	Number	% of Total	Number	% of Total
Park	1960	13,117	99.6	16	0.1	35	0.3
	1970	11,138	99.5	32	0.3	27	0.2
Stillwater	1960	5,511	99.7	12	0.2	3	0.1
	1970	4,595	99.2	23	0.5	14	0.3
Sweetgrass	1960	3,290	100.0	-	-	-	-
	1970	2,978	100.0	2	-	-	-
Yellowstone	1960	78,227	99.0	410	0.5	379	0.5
	1970	85,765	98.2	1,063	1.2	539	0.6
Montana	1960	650,538	96.4	21,181	3.1	3,048	0.5
	1970	663,043	95.5	26,385	3.8	4,981	0.7
United States	1960	158,837,679	88.6	523,591	0.3	19,964,405	11.1
	1970	178,119,221	87.6	763,594	0.4	24,327,343	12.0

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

Rural and Urban

The Upper Yellowstone Planning Area has a large urban population--much more so than the State of Montana (Table III-3). The large urban population is centered in Billings, the largest city in the area.

In past years, rural farm and nonfarm inhabitants have decreased throughout the area, while urban inhabitants have increased. This has also generally been the trend in the rest of the State. Recently, however, there has been a movement of a significant number of people back to rural places (e.g., small acreages outside of corporate limits), resulting in an increase in rural nonfarm population.

Table III-4 illustrates the growth of Billings (and Yellowstone County) as compared to the rest of the area. Billings serves as the primary trade, health, and cultural center of the area--as well as for Eastern Montana and Northern Wyoming.

Educational Attainment

Table III-5 shows the years of formal schooling attained by persons, 25 years of age or older, in the planning area and the rest of the State and Nation. Here the planning area compares very favorably with the State and Nation; educational attainment appears to be consistently higher.

Age Distribution

The age distribution of an area's population may imply the need for certain types of services. For instance, it is readily apparent that recreational and health needs vary among people according to age. Certain age groups are more likely to be participants in the labor force; attitudes of an area can also be influenced by the age composition of its population. Table III-6 illustrates the age distribution of the area's inhabitants.

Outmigration of young job-seekers from the rural counties is evidenced by populations that contain relatively large numbers of middle aged and

Table III-3. Rural and Urban Populations of Upper Yellowstone, Montana: 1960 and 1970 1/

	Upper Yellowstone				State of Montana			
	1960		1970		1960		1970	
	No.	%	No.	%	No.	%	No.	%
Urban 2/	73,542	72.8	82,534	77.9	338,457	50.2	372,344	53.6
Rural	27,450	27.2	23,450	22.1	336,310	49.8	322,245	46.4
Farm 3/	9,887	9.8	7,986	7.5	105,598	15.6	88,640	12.8
Nonfarm 4/	17,563	17.4	15,464	14.6	230,712	34.2	233,605	33.6
Total Population	100,992	100.0	105,984	100.0	674,767	100.0	694,589	100.0

1/ U.S. Census of Population: 1960 and 1970.
2/ Urban inhabitants are defined as persons living in places of 2,500 inhabitants or more.
3/ Rural farm inhabitants are defined as persons living on 10 or more acres with farm sales of $50 or more in the preceding calendar year or on places of less than 10 acres with farm product sales of $250 or more in the preceding calendar year.
4/ Rural nonfarm are persons not meeting the urban or rural farm definitions.

Table III-4. Population of Urban Centers of 1,000 or More Persons, Upper Yellowstone, Montana: 1960 and 1970 1/

Location	1960	1970
Big Timber	1,660	1,592
Billings	52,851	61,581
Columbus	1,281	1,173
Laurel	4,601	4,454
Livingston	8,229	6,883

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

Table III-5. Years of School Completed by Persons 25 Years of Age and Older, Upper Yellowstone, Montana: 1970[1/]

Level	Upper Yellowstone		Montana	United States	Urban	
					Montana	United States
	No.	%	%	%	%	%
Elementary						
0 to 8 years	5,004	8.9	8.9	15.5	7.9	14.2
8 years	8,271	14.7	16.2	12.7	13.8	11.4
High School						
Less than 4 years	7,709	13.7	15.7	19.4	14.6	19.2
4 years	19,477	34.4	34.1	31.1	34.2	31.6
College						
Less than 4 years	9,176	16.3	14.1	10.6	15.9	11.5
4 years or more	6,772	12.0	11.0	10.7	13.6	12.1

1/ U.S. Bureau of Census, 1970 Census of Population.

Table III-6. General Age Distribution of Inhabitants in the Upper Yellowstone, Montana1/

Level	Upper Yellowstone		Montana		United States	
	1960	1970	1960	1970	1960	1970
			Percent			
Under 18 years	38.9	35.6	38.6	36.5	35.9	34.3
18 to 64 years	52.6	55.1	51.7	53.6	55.1	55.8
65 years and older	8.5	9.3	9.7	9.9	9.0	9.9
			Years			
Median age	27.8	27.9	27.6	27.1	29.5	28.5

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

elderly people. For example, in 1970 the United States had an elderly population (65 and over) that composed 9.9 percent of the national total. In contract, the elderly population of Park, Stillwater, and Sweet Grass Counties comprised 14.8, 14.8, and 16.6 percent of the population of those counties respectively. Yellowstone County, which has experienced immigration, has a smaller percentage of the elderly than the Nation.

Income and Income Distribution for Families

It appears that one of the beliefs held by our society is that "more" means "better". Consequently, an individual's income has been viewed as one of the major determinants of how "well off" that individual is. However, other factors may be considered in determining whether or not one group is "better off" than another. Unfortunately, methods do not exist for expressing some of these other factors in comparable and measurable terms (e.g., a preference for living in a small town versus a large city). On the other hand, information concerning income levels is readily available, but it must be viewed in its proper perspective; income is only one factor that may give an insight into an area's overall well-being.

The distribution of families by income class, average income, and median income is shown in Table III-7. The people of the planning area are economically better off as compared to those in the remainder of the State; both median and average incomes are higher. Income seems to be slightly better distributed also, with fewer families in the lower income brackets. U.S. average and median family incomes are higher than those in the planning areas.

Table III-7 shows that income in the study area, the State, and the Nation is not uniformly distributed. In short, there are many more people receiving lower incomes than high incomes. Also, there tend to be greater

Table III-7. Income and Income Distribution of Families in the Upper Yellowstone, Montana, and the United States - 1970 1/

Family Yearly Income 2/	Upper Yellowstone	Montana	United States			
	All Families	All Families	Total	Urban	Rural Nonfarm	Rural Farm
Dollars			Percent			
Less than 2,000	5.4	5.5	5.9	4.9	8.1	10.4
2,000 to 3,999	10.0	10.6	9.3	8.1	11.9	14.8
4,000 to 5,999	12.5	13.1	10.8	9.8	13.0	15.3
6,000 to 7,999	16.2	16.5	12.8	12.1	15.1	14.3
8,000 to 9,999	16.4	15.9	13.9	13.6	14.9	12.6
10,000 to 14,999	24.9	24.7	26.6	28.0	23.8	19.2
15,000 to 24,999	11.6	10.7	16.0	18.0	10.7	9.9
25,000 and over	3.1	3.0	4.6	5.3	2.6	3.3
Average Income ($)	9,765	9,662	10,799	11,674	9,251	8,795
Median Income ($)	8,640	8,512	9,590	10,196	8,248	7,296

1/ U.S. Bureau of Census, 1970, "General Social and Economic Characteristics".
2/ Income is the sum of wages or salary income, nonfarm net self-employment income, farm net self-employment income, Social Security or railroad retirement, welfare income, and all "other" income which includes income from interest, dividends, rentals, public and private pensions, etc.

numbers of people receiving less than the average incomes than there are receiving more than the average income.

Earnings by Sector and Per Capita Personal Income

Certain sectors of an economy are defined to be basic and others non-basic. Basic sectors are those whose output exceeds local needs which results in exports to outside areas. The nonbasic sectors depend on income generated by the basic sectors for their support. Sales by the retail sector to farmers in the area are examples of nonbasic sales but retail sales to nonlocal tourists would be basic sales. A farmer selling his wheat overseas would be making a basic sale. Most economies contain both basin and non-basic sectors. Formal techniques exist for estimating whether or not a given sector is basic but the use of these techniques is beyond the scope of this report.

Manufacturing is the major basic industry in the area. Mining and agriculture are the other basic sectors. Without these basic sectors many of the other sectors would not be able to sustain their current levels of output.

Examination of Tables III-8 and III-9 provides a useful insight into the area's economy. For each of the five years shown, manufacturing was the most important of all the basic sectors; it was closely followed by farming.[1/] Mining importance has remained fairly constant. The figures shown in Table III-8 are in constant 1975 dollars, which means that values have been increased to reflect the general inflation level of 1975. The changes in total earnings, therefore, are mainly due to changes in real

1/ Earnings are the sum of wages and salaries, other labor income and proprietor's incomes in each industry (U.S. Water Resources Council, 1972 OBERS Projections, Series E, Population, Vol. 1, p. 21). These are estimated by place of work.

Table III-8. Personal Income and Earnings by Sector, 1970-1974
Upper Yellowstone, Montana1/

	1970	1971	1972	1973	1974
Total Personal Income (1975 $1,000)	527,359	551,599	603,859	647,518	629,144
Per Capita Income (1975 $)	4,938	5,032	5,445	5,730	5,492
Per Capita Income Relative (U.S.=1)	.93	.93	.96	.96	.94
	Thousands of 1975 Dollars				
Total Earnings	407,333	428,126	475,703	509,703	487,692
Farm	37,728	35,366	53,658	52,573	25,713
Mining	5,255	3,089	5,378	6,089	6,107
Contract Construction	25,178	30,993	34,451	35,184	39,559
Manufacturing	48,286	49,661	54,842	58,476	57,333
Transportation, Communication and Public Utilities	49,602	55,453	60,957	66,232	64,299
Wholesale and Retail Trade	93,668	97,600	101,612	113,419	116,787
Finance, Insurance and Real Estate	18,984	20,522	20,868	22,211	21,850
Services	64,101	65,500	68,521	76,179	76,783
Federal Civilian Government	17,408	18,632	20,194	21,754	21,264
State and Local Government	41,695	45,355	48,344	51,416	52,338
Armed Forces	3,582	3,525	3,793	3,948	3,589
Other and Unaccounted For2/	1,846	2,430	3,085	2,222	2,070

1/ U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, August 5, 1976.
2/ Due to disclosure problems of confidential data, earnings for some sectors for some counties could not be included in the proper sector, but it is included in the total. Consequently, some of those earnings belong to one or more of the other sectors, but there is no way of knowing which sector and how much.

Table III-9. Percent of Total Earnings by Sector, 1970-1974
Upper Yellowstone, Montana[1/]

Sector	Percent of Total Earnings				
	1970	1971	1972	1973	1974
Farm	9.3	8.3	11.3	10.3	5.3
Mining	1.3	.7	1.1	1.2	1.3
Contract Construction	6.2	7.2	7.2	6.9	8.1
Manufacturing	11.9	11.6	11.5	11.5	11.8
Transportation, Communication and Public Utilities	12.2	12.9	12.8	13.0	13.2
Wholesale and Retail Trade	23.0	22.8	21.4	22.3	23.9
Finance, Insurance and Real Estate	4.7	4.8	4.4	4.4	4.4
Services	15.6	15.3	14.4	14.9	15.7
Federal Civilian Government	4.3	4.4	4.2	4.3	4.4
State and Local Government	10.2	10.6	10.2	10.1	10.7
Armed Forces	.9	.8	.8	.8	.7
Other and Unaccounted For	.4	.6	.6	.4	.4

1/ Based on Table III-9.

(physical) output of the economy rather than just general inflation. Some of the fluctuation, however, has been caused by fluctuating prices. One must realize that price changes occur for reasons other than inflation. For example, rising agricutural prices may rise or fall due to changes in supply and demand for/of the commodity. These conditions are also reflected in the 1975 base figures of Table III-8.

Total earnings in 1972 increased by almost $48 million. Direct earnings in the agricultural sector alone accounted for almost $18 million or over 38 percent of the increase. In 1974 total earnings fell by $22 million from 1973. The decline in earnings in the farm sector alone amounted to $27 million. The reasons for these large changes in farm earnings will be examined later. Increased earnings in a few other sectors helped offset some of the impact of the reduced agricultural earnings.

Table III-9 shows that although agriculture was an important basic sector in the planning area, other basic and nonbasic sectors were more important in terms of percent of total earnings. Six basic and nonbasic sectors were ranked higher than agriculture in 1974.

The service, wholesale and retail trade, and transportation/communication sectors had the largest earnings in the planning area; this reflects the importance of Billings as a regional trade center. Fluctuating agricultural prices affect personal and per capita incomes only slightly because the area's economy is so diverse.

Employment

Sector Employment

Another way of gaging the importance of a specific sector is to look at its employment. Employment figures provide a picture of an economic sector that may be different from that provided by earnings (Table III-10).

Table III-10. Employment by Type and Broad Industrial Sources Full and Part-Time Wage and Salary Employment Plus Number of Proprietors, Upper Yellowstone, Montana1/

	1970	1971	1972	1973	1974
Total Employment	44,638	46,252	48,249	51,209	53,367
Number of Proprietors	7,166	7,284	7,435	7,386	7,354
Farm Proprietors	2,546	2,510	2,465	2,428	2,381
Nonfarm Proprietors	4,620	4,774	4,972	4,958	4,973
Wage and Salary Employment	37,472	38,968	40,784	43,823	46,013
Farm	952	1,037	1,040	1,039	1,127
Nonfarm	36,520	37,931	39,744	42,784	44,886
Government	7,179	7,385	7,466	7,737	8,034
Total Federal	1,621	1,562	1,622	1,638	1,766
Federal Civilian	1,471	1,438	1,509	1,516	1,661
Military	150	124	113	122	105
State and Local	5,558	5,823	5,844	6,099	6,268
Private Nonfarm1/	29,341	30,546	32,278	35,047	36,852
Manufacturing	3,655 D2/	3,785 D	4,041 D	4,458 D	4,522
Mining	398 D	336 D	D	401 D	454 D
Construction	1,769	2,166	2,378	2,369	2,629
Trans., Comm. & Public Utilities	3,687	3,857	4,095	4,339	4,389
Trade	10,637	10,855	11,238	12,433	13,166
Fin., Ins. & Real Estate	1,650 D	1,686 D	1,764 D	1,910	2,016
Services	7,356	7,652	8,102	8,952	9,520
Other	104 D	108 D	6 D	162 D	169 D

1/ Compiled by Department of Natural Resources & Conservation, State of Montana. Data from U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System.

2/ A "D" indicates that data for one or more counties is not included due to nondisclosure policies of BEA. Total for private nonfarm is correct.

Examination of sector employment gives some indication of each sector's temporal growth. While employment does not directly reflect output, it does give one an indication of a level of output that has not been masked by price changes. For most nonagricultural sectors output tends to increase along with employment. However, productivity can color the picture provided by employment. For example, since productivity has continued to increase in the farm sector, output has gone up while employment has actually gone down; consequently, it is possible that employment figures could provide a distorted view of the farm sector.

Total employment in the Upper Yellowstone Planning Area increased rapidly from 1970 to 1974. Manufacturing was the basic sector that accommodated the greatest number of additional employees. Trade and services on the nonbasic side showed substantial growth which reflects upon the position of Billings as a regional trade center.

Unemployment

Unemployment in the planning area has been consistently lower than that of the State from 1972 through 1975 (Table III-11). Park County appears to have had relatively high unemployment when compared to the other counties, State, and Nation. On the other hand, Sweet Grass County has had a very low unemployment rate. Overall, Yellowstone County dominates the area employment figures through the sheer size of its labor force. Planning area unemployment rates move with those of Yellowstone County and are never more than two-tenths of a percentage point higher.

The sharp increases in area unemployment shown in 1975 was in response to the national recessionary plunge of that time.

Table III-11. Average Annual Unemployment Rates, Counties of Upper Yellowstone, Montana Planning Area 1972 Through 1975 1/

County	1972	1973	1974	1975
		Percent		
Park	8.2	7.0	7.7	9.6
Stillwater	6.1	5.4	4.8	6.3
Sweetgrass	3.1	3.5	3.2	4.2
Yellowstone	5.6	5.3	5.2	6.7
Planning Area	5.8	5.4	5.4	6.9
State of Montana	6.1	6.2	6.7	8.1
United States	5.6	4.9	5.6	8.5

1/ State and local data from Employment Security Division, State of Montana, Department of Labor & Industry; U.S. data from Council of Economic Advisors, Economic Indicators, September 1976.

Agriculture

The Yellowstone River Valley, which crosses the Upper Yellowstone Planning Area in an east-west direction, is a fertile farmland belt. The agricultural history of the valley dates back to the first permanent settlements. The role of agriculture in the economy has declined somewhat over the last 15 years, but it is still the single most important economic factor in three of the four Upper Yellowstone counties.

The number of farms and ranches in the planning area has declined about 40 percent since 1949 (Table III-12). Although there has been a moderate reduction of land in farms and ranches over the same period of time, the average farm size has increased by about 30 percent from just over 1,350 acres to over 1,750 acres.

It is instructive to examine the value of agricultural products sold shown in Table III-12. Part of the increase shown is due to increased production. However, a large part of the increase, particularly between 1969 and 1974, was due to price. In 1969 the food grain index (wheat is a food grain) had sagged to 87 (price in 1967 = 100); by 1974 price increases had raised the index to 299.[2/] Feed grain prices (e.g., barley) followed a similar but less spectacular pattern. The index for meat animals was 165 in 1974 compared to 119 in 1969.[3/] The value of all agricultural production doubled in five years; food grain prices more than tripled in contrast to meat animal prices which increased by only 39 percent.

The reader may recall that farm earnings (Table III-8) dropped substantially in 1974 from 1973 after having increased substantially between

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2/ U.S. Department of Agriculture, Agricultural Statistics 1975, p. 453.

3/ Ibid, p. 465.

Table III-12. Farm Size, Value of Production and Farm Expenses
Upper Yellowstone, Montana 1/

Source	1949	1954	1959	1964	1969	1974
Number of Farms (#)	3,070	2,960	2,524	2,377	2,281	2,193
Land in Farms (Acres)	4,178,681	4,215,439	4,435,073	4,385,765	4,222,696	3,903,325
Average Farm Size	1,361	1,424	1,757	1,845	1,851	1,780
Total Value of All Ag. Products Sold ($1,000)	23,723	26,903	34,337	38,492	66,147	107,023
Value of Crops Sold (Includes Nursery & Hay) ($1,000)	8,095	9,981	10,271	10,657	11,146	34,026
Percent of Total	34.1	37.1	29.9	27.7	16.9	31.8
Value of Livestock, Poultry & Their Products Sold ($1,000)	15,574	16,855	23,937	27,800	54,925	72,794
Percent of Total	65.6	62.7	69.7	72.2	83.0	68.0
Value of Forest Products Sold ($1,000)	52	66	129	35	75	204
Percent of Total	0.2	0.2	0.4	0.1	0.1	0.2
Farm Production Expenses 2/ ($1,000)	NA	NA	NA	NA	55,483	114,055

1/ U.S. Bureau of Census, Census of Agriculture for all farms.
2/ Not available for all farms until 1969.

1972 and 1973. Agricultural indexes help explain that event. The price indexes for the years 1972, 1973, and 1974 were 109, 214, and 299 respectively for food grains; 105, 162, and 242 respectively for feed grains; and 147, 198, and 165 respectively for meat animals. In short, both grains and meat animal prices increased substantially between 1972 and 1973. Between 1973 and 1974 grain prices continued up, but meat animal prices fell. Since the Upper Yellowstone is primarily a livestock area, its agricultural income was greatly affected. While the value of agricultural products fell between 1973 and 1974, total agricultural expenses increased across the Nation by about 12 percent.[4/] It is reasonable to assume that expenses in the study area increased in a like manner. These changes combined to substantially reduce farm earnings of 1974 from those of 1973.

One often overlooked aspect of agriculture is the expenditures made by that sector for other items. Even when earnings and net income are down for farmers and ranchers, they still have to make about the same amount of expenditures; consequently short term income variations are probably not felt very strongly by the supplying sectors. In addition, farmers and ranchers tend to purchase many of their items locally and in doing so they generate large amounts of business for local merchants. Farm production expenses had approached $115 million by 1974 in the study area. A large part of that $115 million expenditure was gross sales for local businesses.

If farm income was depressed over several years, the supplying sectors would start to feel the crunch also. The likelihood of such an event is probably higher due to weather than due to market conditions.

Crop and Livestock Production

In the past, wheat has been the largest crop in the area (Tables III-13,

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4/ Ibid, p. 465.

14, and 15). More wheat is now grown on fewer acres than in 1949 due to increases in productivity. The productivity increases reflect improved technology and better management.

Hay and feed grain production has also increased steadily since 1949. A large part of the production of hay and feed grains is used locally in the production of livestock. As a consequence, the value of crops sold (Table III-12) does not fully reflect the true level of production; the value of the roughage and feed grain crops is realized indirectly through sales of livestock.

Beef cattle and calves are the most numerous type of livestock produced in the area (Table III-16). The number of cattle and calves has more than doubled since 1949. Sheep and lamb numbers increased from 1949 to 1959 but have dropped by over two-thirds since then. Milk cow numbers have declined steadily since 1949.

Mining

In the last few years, renewed interest has been given to the area's mineral resources. The center of activity is a narrow mineralized zone in Sweet Grass and Stillwater Counties known as the Stillwater Complex. The Complex is an area approximately 30 miles long and five to ten miles wide, totaling approximately 112,000 acres; almost all of which is on National Forest land.

The Stillwater Complex has the largest known chromite and platinum metal reserves in the United States and the second largest nickel reserves. Other minerals included in the ore are copper, palladium, and iron. There has been exploration and mining activity since 1860, and there are four major mining claims in the area presently. The most recent production was by the United States Government during World War II. This production ended in 1961, but there was a stockpile of ore left near the mine just southwest

Table III-13. Historical Production of Irrigated and Nonirrigated Crops
Upper Yellowstone, Montana1/

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Bu.	2,842,141	3,280,578	3,667,690	4,224,030	3,489,940	4,832,245
Rye	Bu.	340	---	9,766	395	4,550	4,550 2/
Corn for Grain	Bu.	29,608	4,186	7,985	17,530	58,100	98,867
Silage	Tons	---	43,676	141,816	143,680	207,650	277,733
Oats	Bu.	666,115	713,473	644,417	571,046	624,863	583,567
Barley	Bu.	640,194	1,097,731	1,990,245	2,095,361	2,495,866	1,853,800
Hay	Tons	196,906	233,680	239,420	285,284	274,779	349,264
Sugar Beets	Tons	179,556	171,838	243,141	252,637	286,336	221,882
Irish Potatoes	Cwt.	28,338	34,920	38,076	10,977	12,284	0
Dry Beans	Cwt.	81,271	113,211	78,249	51,994	26,255	20,500

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.
2/ Agricultural Census for 1969 is most current county estimate available.

Table III-14. Historical Acres of Irrigated Crops Harvested
Upper Yellowstone, Montana1/

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Ac.	20,788	16,031	13,677	10,723	8,568	5,200
Corn for Grain	Ac.	636	88	163	222	900	1,333
Silage	Ac.	725	3,544	8,651	8,148	13,000	14,133
Oats	Ac.	10,091	12,315	9,000	6,918	4,615	4,967
Barley	Ac.	9,307	10,499	10,950	9,449	9,617	8,267
Hay	Ac.	76,192	93,605	84,008	86,304	96,131	129,400
Sugar Beets	Ac.	13,463	12,245	14,922	16,204	15,113	10,913
Irish Potatoes	Ac.	217	229	204	76	56	0
Dry Beans	Ac.	5,852	6,684	4,978	3,241	1,668	1,233

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.

Table III-15. Historical Acres of Nonirrigated Crops Harvested
Upper Yellowstone, Montana1/

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Ac.	181,446	170,493	154,681	141,000	136,079	164,233
Rye	Ac.	31	---	582	19	136	136 2/
Corn for Grain	Ac.	232	53	27	---	63	0
Silage	Ac.	1,112	1,423	1,037	360	489	267
Oats	Ac.	7,851	8,120	6,408	5,577	7,447	8,467
Barley	Ac.	20,234	38,933	64,299	58,481	50,350	50,333
Hay	Ac.	76,672	61,251	62,036	75,695	56,077	66,733
Sugar Beets	Ac.	176	37	---	48	---	0
Irish Potatoes	Ac.	78	61	16	3	7	0
Dry Beans	Ac.	563	69	---	---	---	0

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.
2/ Agricultural Census for 1969 is most current county estimate available.

Table III-16. Number of Head of Livestock
Upper Yellowstone, Montana1/

AREA: Upper Yellowstone, Montana

Livestock	Unit	1949	1954	1959	1964	1969	Base
All Cattle & Calves	#	159,742	221,275	218,551	267,409	298,700	328,900
Milk Cows	#	12,810	12,422	9,085	7,425	4,691	3,300
All Sheep & Lambs	#	132,980	131,422	188,270	111,171	77,280	52,890
All Hogs & Pigs	#	10,080	11,619	19,299	16,361	18,291	21,550 2/
Chickens 4 Months & Older	#	113,364	185,832	155,439	133,613	149,901	156,150 2/
Horses & Ponies	#	---	7,508	7,046	---	6,750	7,374 3/

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is 1974 data from SRS unless noted otherwise.
2/ 1972 and 1973 average.
3/ State of Montana. report of the State Department of Revenue - 1974. This estimate is used since Agricultural Census estimates miss horses that are not on farms.

of Nye. This stockpile is being hauled in trucks to the railroad at Columbus, and depletion of this source is expected within four years.

The most recent exploration activity began in 1966 with the presence of four companies--Anaconda Company, Johns-Manville, AMAX Exploration, Inc., and Cypress. Johns-Manville activity is focused on platinum and palladium, while Anaconda and AMAX appears to be interested in nickel and copper deposits.

Manufacturing[5/]

Billings has three important manufacturing subsectors that serve national markets and are a significant part of the industrial base of Yellowstone County; these subsectors include sugar refining, meat packing, and petroleum refining.

The Yellowstone River Basin of Montana and the Big Horn Basin of northwest Wyoming have historically been important sugar beet areas. The Great Western refinery opened in Billings in 1906 and has run every year up to the present time. Over the 70-year history of the plan, an average of over 3,000 tons of beets has been processed each day of the "campaign" and the campaign has run for an average of slightly less than 100 days per year.

There are two large packing houses in Billings--Pierce Packing Company and Midland Empire Packing. The economics of the packing industry depends largely on the geographic location of consumers and of supplies of feed grain. Fluctuations in the price of wheat are critical to the economics of the feeding and slaughtering businesses. Wheat was used as a feed grain in the early 1970's but by 1973, prices were bid up by the demand for wheat as a cereal grain. If wheat prices become low enough (relative to barley) then wheat may be used as a feed grain. In that case, Montana suddenly

5/ Montana Demographic Study, Mid-Yellowstone Areawide Planning Organization, July, 1976.

could become a large feed grain surplus area, and beef fattening and slaughtering are likely to be profitable. When the price of wheat rises relative to that of barley to the point that it can not be economically used as animal feed, then the midwestern corn belt becomes the only surplus feed grain area in the country, and it is much more efficient to ship the cattle to the grain rather than the grain to the cattle.

Petroleum Refining

There are three oil refineries in Yellowstone County--Continental and Exxon in Billings and Farmers Union In Laurel. The combined total of Montana and Wyoming crude oil has remained quite stable for each refinery over the 15-year period. However, the importation of Canadian crude has allowed both Exxon and Farmers Union to increase their throughput by about five million barrels per year since the early 1970's, and Canadian crude has been the major portion of Continental's feedstock since the mid-1960's.

Unfortunately, the Canadian Government has recently announced that exports of petroleum feedstocks would be drastically curtailed until there would be no exports at all to the United States by 1982. Implications for the Billings refineries are complicated and will involve many contingencies that are undetermined at this time.

Regional Trade Center

Another component of the economic base of the Upper Yellowstone Planning Area is the role of Billings as a trade, services, and transportation-communcations center for southern Montana and northwestern Wyoming. Billings is much more highly developed in each of these sectors than could be expected solely on the basis of the local market area. Yellowstone County provides a broad range of services not only to its own residents and to those of the other Upper Yellowstone counties, but also to persons living within a radius of several hundred miles from Billings.

Probably the most conspicuous employer that depends on Billings' role as a regional center is the health services industry. Its two hospitals employed over 1,200 persons in the summer of 1976, and the Billings Clinic employed an additional 220 persons. All three institutions seem to have very similar service areas deriving about 65 percent of their patients from the Upper Yellowstone Area, 10 percent from Wyoming, and the remainder from other parts of Montana.

Tourism

Tourism makes a major contribution to the area economy. Billings-Red Lodge and Livingston-Gardiner lie on two of the five entrance routes to Yellowstone National Park. Most of the tourists from the northern and eastern part of the Nation that are headed for Yellowstone or Glacier Parks, or to areas in the Pacific Northwest, Alaska, or southwestern Canada, pass through the area. Many small businesses in the area are almost wholly dependent on tourist trade.

CHAPTER IV

PROJECTED REQUIREMENTS

The source of the information presented in this chapter is a collection of several Ad Hoc Group reports done specifically for this Level B Study. The reader is referred to the individual reports for more detailed explanations of the methodology used for each of the topics that follow.

Agriculture

The base figures shown above (Tables III-13 through III-16) in the discussion of the agricultural sector are also included in the following tables which present the OBERS projections for comparison. Since crop and livestock production and the amount of land used in that production tend to fluctuate from year to year, no one year is truly representative of the agricultural situation. To provide an accurate representation of the base condition, production data from 1972, 1973, and 1974 were averaged to represent the base year of 1975. Actual 1975 data was not used because it was not available at the time this work was undertaken.

The OBERS projections stemmed from work performed by the Office of Business Economics (OBE) and the Economic Research Service (ERS); OBERS is the acronym which combines the abbreviations of the two agencies.

The OBERS program arose from a need for a comparable data base that could serve the entire nation and its regions in a consistant and uniform manner. Although the OBERS projections are used in this planning effort, they in no way have restricted the use of other projections in the planning process.

Population growth, per capita income levels, crop and livestock prices, and foreign demand for commodities are a few of the more important variables used to formulate the OBERS projections at the national level. By assuming changes in the action of the variables, different sets of national demands can be projected. This report deals with two sets, the OBERS series E and E' projections.1/

The OBERS E' projections are more recent than the E projections and reflect increased grain exports and increased agricultural productivity.

Once national projections were made, they were disaggregated by the various states; from there, they were disaggregated to the individual planning areas by the Agricultural Ad Hoc Group.2/

Nonirrigated Cropland

Table IV-1 illustrates the OBERS projections (E and E') for nonirrigated croplands in the years 1985 and 2000. The projections for harvested acres range from 226,627 acres under E to 298,400 under E' by the year 2000.

In short, only under the assumption of increased exports of OBERS E' does the total remain near that of the base year. However, both the E and E' forecasts show decreases in total harvested acres through 1985.

Irrigated Cropland

Total irrigated acres in the Upper Yellowstone are projected to decline by OBERS under both E and E' (Table IV-2). Therefore, it appears that there is no need to expand irrigation in the planning area over the next 25 years--given the projections in Table IV-2.

1/ The Department of Commerce, Bureau of Census, has made several series of population projections which they label as C, D, E, etc. Series E assumes a birth rate which will eventually result in no further population growth in the United States--except for immigration.

2/ See Agricultural Projections and Supporting Data, Agricultural Ad Hoc Work Group Report, February 1977.

Table IV-1. Projected Acres of Harvested Nonirrigated Crops for 1985 and 2000, Upper Yellowstone, Montana

Crop	Unit	Base 1/	Series E 1985	Series E 2000	Series E' 1985	Series E' 2000
Wheat	Ac.	164,233	111,471	100,254	129,059	124,920
Rye	Ac.	136 2/	97	70	129	117
Corn for Grain	Ac.	0 2/				
Silage	Ac.	267	1,072	1,129	1,353	1,615
Oats	Ac.	8,467	7,601	6,635	8,861	10,066
Barley	Ac.	50,333	62,833	68,064	69,980	79,432
Vegetables	Ac.	292 2/				
Hay	Ac.	66,733	47,494	50,475	66,985	82,250
Sugar Beets	Ac.	0 2/				
Irish Potatoes	Ac.	0 2/				
Total	Ac.	290,198	230,568	226,627	276,367	298,400

1/ 1972-1974 average unless noted otherwise.
2/ 1969 Agricultural Census.

Table IV-2. Projected Acres of Harvested Irrigated Crops for 1985 and 2000, Upper Yellowstone, Montana

Crop	Unit	Base[1/]	Series E		Series E'	
			1985	2000	1985	2000
Wheat	Ac.	5,200	7,607	7,143	7,500	7,040
Corn for Grain	Ac.	1,333	557	91	431	105
Silage	Ac.	14,133	10,888	10,919	10,735	10,762
Oats	Ac.	4,967	5,674	5,689	5,595	5,607
Barley	Ac.	8,267	7,423	6,709	7,319	6,613
Hay	Ac.	129,400	109,186	110,169	107,656	108,586
Sugar Beets	Ac.	10,913	12,384	13,786	17,669	19,165
Irish Potatoes	Ac.	0	56	37	57	41
Dry Beans	Ac.	1,233	1,520	1,053	1,337	891
Total	Ac.	175,446	155,295	155,596	158,299	158,810

1/ 1972-1974 average unless noted otherwise.

However, Table IV-3 presents an OBERS forecast of increased cattle production in the planning area under both E and E'. This appears to be in direct conflict with the projections found in Table IV-2.

The Agricultural Ad Hoc Group, felt that OBERS had fallen far short in relating its forecasted red meat (beef) production to the amount of grain and roughage needed to sustain that level of production. To more accurately reflect the effects of increased red meat production on demand for future irrigation, the group devised a means to modify the OBERS projections--so the "third projections" (3E and 3E') were evolved.

The best interpretation that can be given to the third projection is that it represents a high level of demand. That level assumes: (1) the OBERS livestock projections are about right; (2) the historical method of production (i.e., cow-calf rather than feeder operations) of cattle will continue in the future; and (3) there will not be a major shift in crop production away from cash crops such as wheat and sugar beets. Table IV-4 demonstrates needed future production (measured in feed units) of roughage and grain to meet the OBERS livestock projections.[3/]

Assuming that enough alfalfa is grown to remove the total deficit and to satisfy livestock demand for additional feed units in the Upper Yellowstone Planning Area (alfalfa contains 1100 feed units per ton), then an additional 183,000 to 208,500 new irrigated acres must be added by 1985 and 236,000 to 266,000 acres by the year 2000. Another assumption here is that none of the additional demand for roughage is met by expanding nonirrigated acres. If this is the case, then the roughage demand for new irrigated acres would be that presented in Table IV-5.

3/ One feed unit is the food value of one pound of No. 2 corn. Agricultural Projections and Supporting Data, Part III, February, 1977.

Table IV-3: Projected Livestock Production for 1985 and 2000, Upper Yellowstone, Montana

Livestock	Unit	Base1/	Series E		Series E'	
			1985	2000	1985	2000
			Thousands			
Beef and Veal	Lbs.	100,800	141,475.7	165,321.5	141,178.6	177,719.5
Pork	Lbs.	7,303	7,361.8	8,436.7	7,019.9	8,459.6
Lamb and Mutton	Lbs.	2,504	3,113.7	2,633.9	1,182.0	924.0
Chickens	Lbs.	532	442.3	298.3	487.8	330.1
Eggs	Doz.	2,338	2,590.1	2,186.1	2,418.1	2,195.1
Milk	Lbs.	28,893.3 2/	25,260	18,205	27,612	18,521

1/ 1974 average unless noted otherwise.

2/ Montana State Department of Business Regulation, Milk Price Control Board.

Table IV-4. Livestock Feed Units Produced and Consumed
OBERS Series E and E', 1985 and 2000,
Upper Yellowstone, Montana

Series	Feed Units Produced		Feed Units Required		Excess or Deficit Feed Units		
	Roughage	Grains	Roughage	Grains	Roughage	Grains	Total
E (1985)	1,170,561	220,081	1,816,688	202,518	-646,127	17,563	-628,564
E' (1985)	1,201,812	241,066	1,794,880	198,781	-593,068	42,285	-550,783
E (2000)	1,261,492	252,300	2,106,700	224,221	-845,208	28,079	-817,129
E' (2000)	1,289,501	291,970	2,244,867	238,883	-955,366	53,087	-902,279

Source: Agricultural Projections and Supporting Data, Agricultural Ad Hoc Group, February, 1977

Table IV-5. Base Acres, OBERS Projections, 3E, and 3E' for Irrigated Lands, Upper Yellowstone, Montana

Projections	Acres 1985	Acres 2000
Base Year	175,446	175,446
OBERS E	155,295	155,596
OBERS E'	158,299	158,810
3E	383,863	411,749
3E'	358,584	441,656

In using these projections for planning purposes, it must be kept in mind that the 3E and 3E' forecasts indicate a high level of future demand while OBERS E and E' indicate a low level of future demand. Actual demand for agricultural products and related irrigated acres in the future lie somewhere in between.

Figure IV-1 locates existing irrigated lands and irrigable lands; there are approximately 466,000 irrigable acres in the planning area but only a small percentage is feasible for actual irrigation.

Saline Seeps

In recent years, the saline seep problem has been identified as a major threat to agricultural productivity throughout Central and Eastern Montana. According to a recent publication by the Montana Department of Health, another less recognized, but equally important, problem is the long-term impact of saline waters on hydrologic systems (i.e., rural and domestic stock wells, ponds, reservoirs, springs, streams, and municipal water supplies).[4/]

4/ See Investigation of Salinity in Hydrological Systems in Montana, Water Quality Bureau--Department of Health and Environmental Sciences, July, 1975.

PLATE IV-1 IRRIGATED AND IRRIGABLE LANDS

Legend

Irrigated Lands

Irrigable Lands

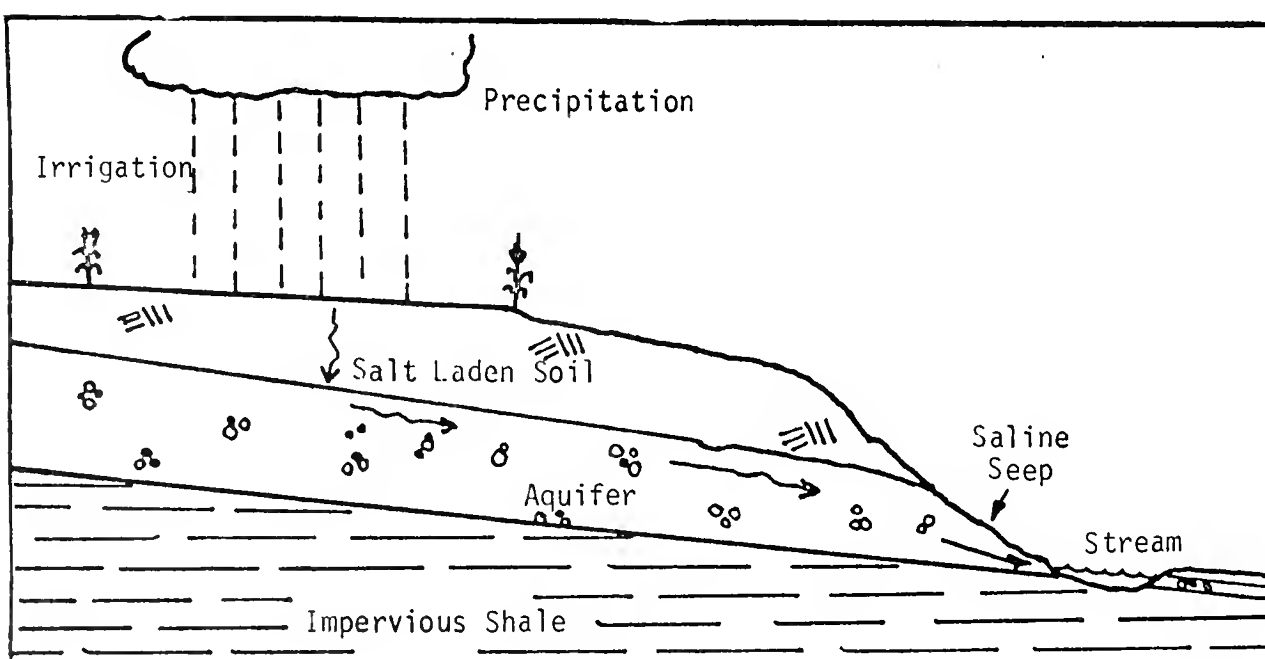
Drainage Boundary

YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

The portions of the Yellowstone Basin that have been affected by saline seeps are usually underlain by a thin aquifer which, in turn, lies over some thick, impervious shale or dense clay strata. The potential exists for many of these shallow aquifers to become polluted by saline waters given some impetus by man's farming activities. Shallow ground water represents a particularly valuable resource in Eastern Montana, where it serves as the primary source of water for man and animal alike; there are few alternative sources of water so pollution of the groundwater with salts could cause a real economic hardship in areas so affected.

Figure IV-1 illustrates the dynamics of a saline seep. Water infiltrates a salt-laden solution. Naturally occurring salts, found in the soil, go into solution and move with the water through the soil into the aquifer. At this point, the saline water moves laterally through the aquifer above the impervious shale to a discharge area (i.e., a spring, seep, or stream).

Figure IV-1. Formation of a Saline Condition



In dryland farming areas, saline seeps appear to be directly related to farming methods that leave the land fallow. During wet years the moisture content of the soil will increase to the point where excess moisture percolates through the ground to an extent that a seep condition develops. Salts originating from overuse of water on irrigated lands may also cause seep conditions, and is also a growing problem in Montana.

Table IV-6 shows the number of acres affected by saline seeps and irrigation salinity in the Upper Yellowstone Planning Area.

Table IV-6. Estimated Acreage Affect by Salinity Conditions, Upper Yellowstone, Montana 1/

Planning Area	County	Acres	
		Saline Seep	Irrigation Salinity
Upper Yellowstone	Park	-	669
	Sweet Grass	-	3,000
	Stillwater	23,000	900
	Yellowstone	600	2,000

1/ Source: Investigation of Salinity in Hydrological Systems - Water Quality Bureau, July 1975.

Domestic, Industrial, Non-Energy Mineral, and Livestock Water

Domestic

Table IV-7 shows projected population increases for the Upper Yellowstone Planning Area which relates to possible levels of energy (coal) development in Eastern Montana.5/ Associated with each population figure is the amount of water consumed by that population. The consumptive use is roughly 35 percent of 185 gallons per person-day.6/ Approximately 65 percent returns to the water ways as waste-water.

5/ See Current and Projected Population, Incomes and Earnings, Ad Hoc Group on Projections.

6/ Ad Hoc Work Group on Unit Water Requirements.

Table IV-7. Population Projections and Associated Consumptive Water Requirements, Upper Yellowstone, Montana

Projection	Base Year	1985	2000
Current (Population)	117,700	-	-
af/y	6,798	-	-
Low (Population)	-	140,000	153,800
af/y	-	8,086	8,884
Most Probable (Population)	-	141,324	157,560
af/y	-	8,163	9,100
Extensive (Population)	-	141,870	160,225
af/y	-	8,195	9,255

At the present time, public and private wells serve 52 percent of the area's population while public surface sources serve the remaining 48 percent. Some residents may be served by both.

Industry and Non-Energy Minerals

Within the industry category is included the manufacture of (1) petroleum, (2) food and kindred products, and (3) other.7/ Non-energy minerals include: (1) stone, (2) sand and gravel, (3) lime, and (4) chromite.8/ Table IV-8 shows estimates of base and future consumptive water use by these sectors.

Table IV-8. Industrial and Non-Energy Consumptive Use, Upper Yellowstone, Montana

	af/y		
Sector	1975	1985	2000
Industrial	8,700	9,400	10,100
Non-Energy Minerals	37	52	739 1/
Totals	8,737	9,452	10,839

1/ Mining and related activities in the Stillwater Complex.

7/ U.S. Department of Commerce, Special Report Series: Water Use in Manufacturing, 1975.

Livestock

Water is consumed in two ways in its use by livestock: first through its actual physical consumption and second, through evaporation from stock ponds. Evaporation is significantly greater than actual consumption.

According to the OBERS projections the demand for red meat is expected to increase over the next 25 years. Tables IV-9 and IV-10 illustrate actual and evaporative consumption based on these projections.

Flood Control

The Corps of Engineers (COE) and the Soil Conservation Service (SCS) were given the task of describing flood damages and streambank erosion damages in the base year of 1975 and projecting those damages for the years 1985 and 2000.9/

The COE was given the responsibility for the main stem reaches having at least 400 square miles of drainage area. Complementing this, the SCS was given the tributary streams having less than 400 square miles of drainage area.

Both the COE and the SCS made their estimates and projections based on the Missouri Basin Framework Study and the National Streambank Erosion Assessment. In developing their data, they assumed that (1) current trends toward increased flood plain regulation would continue into the future; and (2) no additional structural measures (past 1975) would be added in the study area.

8/ See Non-Energy Mineral Industry Water Needs, Yellowstone River Basin Study Area, 1985 and Year 2000, Ad Hoc Group on Updating Minerals Data, May, 1977.

9/ See Flood Damages and Streambank Erosion Damages Along Main Stem Reaches, Corps of Engineers, December, 1976, and Flood Control and Streambank Erosion Needs: Drainage Areas Less than 400 Square Miles, Soil Conservation Service, November, 1976.

Table IV-9. Livestock Water Requirements,
Upper Yellowstone, Montana1/

Animal Type	Water Requirements: Livestock af/y				
		1985		2000	
	Base Year	E	E'	E	E'
Beef	3,508	4,925	4,914	5,627	6,185
Milk Cow	88	77	84	55	56
Sheep	94	117	44	99	35
Hogs	58	58	56	67	67
Poultry	8	8	8	8	8
Horses	78	78	78	78	78
Totals	3,834	5,263	5,184	5,934	6,429

1/ Exclusive of evaporation from stockwater impoundments--See Table IV-10.

Table IV-10. Evaporation from Stockwater Impoundments,
Upper Yellowstone, Montana

Ownership	Number			Evaporation af/y2/		
	1975	1985	2000	Base	1985	2000
Private	1,065 1/	1,129	1,310	8,520	9,008	10,480
Federal	46	63	63	368	504	504
Totals	1,111	1,192	1,373	8,888	9,512	10,984

1/ Estimate based on SCS data.

2/ Assume average of 2 acre feet in size and 4 af/y per acre evaporation.

Table IV-11 shows current flood damages in the Upper Yellowstone Planning Area by category: (1) crop and pasture, (2) other rural, and (3) urban. The SCS data on tributaries is shown in script. Table IV-12 displays current and projected flood damages for 1985 and 2000. Both tables indicate that damages from flooding of the tributaries is greater than that of the main stem reaches.

Existing data regarding streambank erosion damages could not be disaggregated to fit the Level B Planning areas. Therefore, streambank erosion damages for the Level B Study were developed by state as done in the National Streambank Erosion Assessment. Table IV-13 shows estimated streambank erosion damages for the years 1975, 1985, and 2000 for all of the basin's major rivers and their small Montana tributaries. Streambank erosion may be caused by: the abrasive action of ice jams; banks caving during (and following) flood occurrences; and undercutting which may take place throughout the range of streamflows. Streambank erosion may be critical in local areas where it affects facilities such as highways, bridges, irrigation structures, or water plant intakes.

Indian Water Requirements

To understand the situation surrounding Indian water rights in Montana, one must first examine the "Federal reservation system or doctrine." In its simplest form, the reservation doctrine means that if the United States Government reserves a portion of the public domain for a federal use which will ultimately require water, and intends to reserve unappropriated water for that purpose, then sufficient amounts of water for that use are reserved from appropriation by private users.

The effect of the doctrine is twofold: (1) when the water is eventually put to use, the water right of the United States will be superior to private

Table IV-11. Current (1975) Flood Damages Along Combined Reaches, Upper Yellowstone, Montana1/

Stream and Reach	Crop and Pasture	Other Rural	Urban	Total
		($1,000)		
Yellowstone River				
Wyoming Line to Billman Creek	9	6	0	15
Billman Creek to Clarks Fork	37	207	71	315
Clarks Fork to Bighorn River	180	270	31	481
Shields River				
Horsefly Creek to Mouth	10	7	1	18
Boulder River				
West Boulder Creek to Mouth	3	6	0	9
Stillwater River				
West Fork to Mouth	5	11	0	16
Upper Yellowstone Tributaries	*308*	*303*	*850*	*1461*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table IV-12. Current (1975) and Projected Flood Damages Along Combined Reaches, Upper Yellowstone, Montana1/

Stream and Reach	Area Subject To Flooding	Flood Damages 1975	1985	2000
	(1,000 acres)	($1,000)		
Yellowstone River				
Wyoming Line to Billman Creek	3.0	15	16	17
Billman Creek to Clarks Fork	36.8	315	331	354
Clarks Fork to Bighorn River	40.0	481	505	541
Shields River				
Horsefly Creek to Mouth	3.5	18	19	20
Boulder River				
West Boulder Creek to Mouth	1.4	9	9	10
Stillwater River				
West Fork to Mouth	2.0	16	17	18
Upper Yellowstone Tributaries	*63.6*	*1,461*	*1,753*	*2,484*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table IV-13. Streambank Erosion Damages, Level B Study Area: 1975, 1985, and 2000

Main Stems	Annual Damages 1975	1985	2000
		($1,000)	
Upper and Lower Yellowstone Planning Areas			
Yellowstone River	217	338	382
Main Tributaries1/	85	133	150
Upper and Lower Clarks Fork and Bighorn Planning Areas			
Clarks Fork River	32	49	56
Bighorn River	291	453	511
Upper and Lower Tongue and Powder Planning Areas			
Tongue River	55	85	96
Powder River	140	217	245
Montana Tributaries2/			
Yellowstone, Clarks Fork, Bighorn, Tongue, & Powder Rivers	61.5	95.7	108.1
Little Missouri River	7.8	12.1	13.6
Totals	69.3	107.8	121.7

1/ Drainages of more than 400 square miles.

2/ Drainages of less than 400 square miles.

water rights which were acquired after the date of the reservation; and (2) the federal use is not subject to state laws regulating the appropriation and use of water. The origin of the doctrine was set forth by the U.S. Supreme Court in the case of United States vs. Rio Grande Dam and Irrigation Company, 174 U.S. 680 (1899).

The cornerstone of the Indian water right issue is found in Winters vs. United States, 207 U.S. 564 (1908) which stated that when the Federal Government created the Fort Belknap Indian Reservation (Montana), it reserved not only the land, but also the use of enough water to irrigate the irrigable portions of those lands. This was based on the supposition that the Indians could not support themselves on the Reservation land without irrigation and that the Government had intended for the Indians to be self-supporting. Subsequent to this decision, other court cases have been added to this to become the body of law that is now known as the Winters Doctrine.

A significant case, United States vs. Ahtanum Irrigation District, 236 F. 2d 231, (CCA-9) (1956), aspects of which were litigated as late as 1964 330 F. 2d 889 (CA-9) (1964), resolved at least three important issues: (1) it was established that rights reserved by treaties are not subject to appropriation under State law; (2) alleged rights to water are not subject to the defense of laches or estoppel (the Indians did not lose their right to the use of the water because of their failure to make timely development); and (3) transferees, of fee patented Indian Allotments, acquired a vested interest in and right to distribution of the water.

Another benchmark case, Arizona vs. California, 373 U.S. 601, 835 Ct. 1498, 10 L. Ed. 578 (1963) held that Indian water could be used for industrial purposes and other uses not contemplated at the time of the treaty, and that the principles underlying the reservation of water rights for Indian Reservations are equally applicable to other Federal establishments.

Tweedy vs. Texas Company (C. 2738) U.S. District C. Montana (June 14, 1968) held that ground water was also included in the Indian Water right.

Litigation concerning Indian water rights in Montana's portion of the study area is currently pending in Federal District Court in Billings. Three lawsuits are pending; two of the actions were brought by the United States on its own behalf and on the behalf of the Crow and Northern Cheyenne tribes. The purpose of the suits is to have the water rights adjudicated in the Tongue and Bighorn River Drainages. The third suit was brought by the Northeryn Cheyenne tribe on its own behalf to adjudicate the water rights in the Tongue River and Rosebud Creek. There are a few thousand private water users and several state agencies named as defendants in the three lawsuits.

Given the complexity and magnitude of the Indian water rights issue, the Yellowstone Level B Study has elected to treat water related developments on the Crow and Northern Cheyenne Indian Reservations in the same manner off-reservation development is being treated. At this time there are potential irrigation projects as well as energy related potentials that exist on Indian lands; the Hardin Bench unit is the most significant potential irrigation project lying across Indian lands (see Clarks Fork-Bighorn Chapter VI for a discussion of this project).

Instream Flows

The instream flow requirements for the Upper Yellowstone Planning Area were developed by the Montana Department of Fish and Game.[10/] The requirements found in this section are identical to those used by the Department in the water reservation request to the Montana Board of Natural Resources and Conservation.[11/]

10/ See Instream Flow Needs Ad Hoc Work Group Report, Series of Memorandums from Liter Spence.

11/ See Legal Constraints on Resource Development in the Yellowstone River Basin, June 1977.

The instream flow requirements as presented in table IV-14 will help maintain the existing environment in and adjacent to the river. The following requirements for the upper reach of the Yellowstone (Gardiner to the Bighorn River) were derived from daily flow duration hydrograph data obtained from U.S. Geological Survey. The mean flow (table IV-14) which was equaled or exceeded 50 percent and 70 percent of the time over the period of record was used and was obtained from tables of plotting points furnished with the duration hydrographs. Periods when 50 percent and 70 percent exceedance flows were used are as follows:

Gardiner - Clarks Fork			Clarks Fork - Bighorn		
Jan. 1	- May 10	50% Exceedance	Jan. 1	- April 30	50% Exceedance
May 11	- Aug. 10	70% Exceedance	May 1	- July 31	70% Exceedance
Aug. 11	- Dec. 31	50% Exceedance	Aug. 1	- Dec. 31	50% Exceedance

Gage records for three main Yellowstone River Stations and three major tributaries were used to obtain flows in the main river. The following gage stations were used (period of gage record used is shown in parenthesis):

(1) Yellowstone River at Corwin Springs (1926 - 1974)
(2) Yellowstone River near Livingston (1901 - 1967)
(3) Shields River at Clyde Park (1929 - 1960)
(4) Boulder River at Big Timber (1956 - 1974)
(5) Stillwater River near Absaroka (1936 - 1974)
(6) Yellowstone River at Billings (1932 - 1971)

Flow of each of the above tributary streams was added to the flow in the main river to arrive at mainstem flow below each tributary. Tributary flows were also derived as the mean flow equaled or exceeded 50 percent and 70 percent of the time over the period of record as given in duration hydrograph data from the USGS. Those flows equaled or exceeded 50 percent and 70 percent of the time were believed to be the minimum requirement to maintain some semblance of the existing aquatic ecosystem.

The exceptions to the above method of estimating flows are those flows in the Yellowstone River between Yellowstone Park and the Boulder River for the periods January through April and August through December. In those cases the "instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach" were recommended.

Table IV-14. Instream Flow Requirements in the Yellowstone River--Gardiner to the Bighorn River--by Segment (cfs)

Stream Reach	Jan	Feb	Mar	April	May 1-20	May 21-31	June	July 1-20	July 21-31	Aug	Sept	Oct	Nov	Dec
Gardiner to Big Creak	The instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach.				2800	6400	9400	5500	3700	The instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach.				
Big Creek to Shields River					3000	6900	11500	7700	5000					
Shields River to Boulder River	(Same)				3400	7300	11300	7800	5100	(Same)				
Boulder River to Stillwater River	1200	1300	1300	1700	3800	8500	14700	9200	5700	3500	2300	2000	1800	1500
Stillwater R. to Clarks Fork of Yellowstone	1500	1500	1600	2000	4500	9900	17600	11500	7000	4200	2800	2500	2200	1800
Clarks Fork to Big Horn River	2200	2200	2600	3000	6000	12500	20300	11500	6000	3800	3000	3000	3000	2200

The Yellowstone River is unique in this nation in that it is one of the few remaining major "free flowing" streams left in the continental United States. This stream blends harmoniously with its surrounding environment. The upper Yellowstone (upstream from the Boulder River) is characterized by its clean, cold, highly productive water. Its trout fishery in these upper reaches is renowned nationwide. It provides high quality fishing for rainbow, brown and Yellowstone cutthroat trout. The Yellowstone cutthroat is a unique species found only in the upper Yellowstone basin. Mountain whitefish are also abundant and provide an important winter fishery.

In view of the importance of this famous river, it is felt that establishment of a single set of "numbers" as recommendations for instream flow needs during other than the highest flow months would be a first step in degrading the high quality of the "blue ribbon" portion (from Gardiner to the Boulder River) of the river and its fishery. Simply assigning a monthly flow "number" to this part of the river would eventually place limitations on the fishery which do not exist today. Because the Yellowstone is unregulated, aquatic resources have evolved to existing relative numbers and status due to a multitude of historical streamflow conditions (i.e., the extreme highs and lows as well as all other flows in between). Thus to eventually limit flows to a monthly "number" could effectively alter the status of those existing aquatic resources. It was felt that the low flow points between August and April are most critical to maintain (Table IV-14), and that flows should not be established at a "number" for purposes of the EQ plan of this study.

Naturally all existing water rights in the basin must have priority over new water uses. This priority is recognized by these recommendations.

Only during the spring runoff periods of May-July did it seem infeasible to recommend an instantaneous flow, since this would include floods and other extreme high water conditions. Although it is believed high spring flows are

necessary to maintain channel integrity (which in turn helps provide fish habitat), it is not currently known how much flow is necessary on an annual basis to accomplish this task. Therefore, the 70 percent exceedance level was recommended during this period as described above. Table IV-14 illustrates the instream flow estimates needed to maintain the existing aquatic ecosystem.

The Yellowstone River between the Boulder River and the Bighorn River is a transition zone between the primarily cold water environment of the upper river and the warm water environment of the lower river. It contains fish species common to both the upper river and the lower river (below the Bighorn River). Although this reach is not without its importance as part of the entire river system, it must be rated below the upper river in its importance to the State and the Nation. However, only small amounts of aquatic resource data have been obtained on this stretch of the river and its importance may not yet be fully realized.[12/]

Energy

No new coal-related energy developments have been forecast for the Upper Yellowstone Planning Area in the Level B Study. The coal areas lie to the east in the Lower Yellowstone and Tongue-Powder Areas. The reader is referred to these reports for the energy forecasts and plans. The reader should note, however, that the possible impacts on this area from coal development (e.g., population) are considered in this report.

Outdoor Recreation

The Upper Yellowstone Area is the most extensively developed of the four Montana planning areas because of its major population centers, and as a

12/ See EQ Plan in Chapter VI for more detailed discussion of the above.

result it has the greatest need for developed facilities. This, coupled with the fact that the area has taken advantage of the national (and international) drawing power of its outdoor resources, had led to tremendous pressures being put on the area's existing outdoor recreation areas and facilities.

The Yellowstone River and its tributaries (aside from Yellowstone National Park) are the major recipients of these recreational pressures. However, public access on many stream reaches is extremely limited. Where access is provided, facilities are not present to provide for a range of activity preferences.

Without Federal or State involvement in providing access and/or facilities for future use of the areas outdoor resources, user satisfaction will decrease markedly due to severe competition for a fixed amount of space. State and Federal agencies must make every effort to guarantee access to public lands and waters in the area in order to mitigate or satisfy future recreational needs.

Projected Requirements

The methodology for deriving demand figures for outdoor recreation activities in the area is a function of current and future population estimates.[13/] Participation rates were multiplied by the current and future population estimates for 1985 and 2000, producing estimated activity occasions. By using design load factors and standards for recreation activities, the total number of acres needed to support those activities was obtained. Acreage estimates needed to satisfy demand were developed by utiliziing both land and water standards in the case of swimming, water skiing, and boating/canoeing. Winter sports were divided into the two categories of ice skating and snow skiing. The activities of driving and sightseeing were omitted because no standards were provided.

13/ See Outdoor Recreation Update, Recreation Ad Hoc Work Group, May, 1977.

Table IV-15 shows needs for surface acres related to most types of outdoor recreation both in 1975 and in the future.[14/] The greatest need appears to be that for water-based recreation.

Land Conservation

An acute awareness of the need for conservation of our basin resources--soil and water--has led to the development and implementation of many conservation programs since 1940. Paramount among these programs are conservation farming techniques and improved forest and range management practices. The Multiple Use-Sustained Act of 1960 for National Forest Lands and the Federal Land Policy and Management Act of 1976 for the Public Domain Lands have added impetus to land conservation by ensuring that conservation values would not be sacrificed to exploit other resources.

Land conservation measures preserve and improve the land, water, and plant resources. Measures specifically designed to control wind and water erosion will also contribute to the reduction of flood hazards in rural and urban areas, improve water disposal in needed areas, and generally enhance recreational and fish and wildlife values. While measures may vary from one area to another, the long-term result common to nearly all measures is that of sustained or increased production. Land conservation measures, such as improved irrigation systems, would decrease water diversion requirements.

It has been estimated that stream sedimentation could be expected to decrease by 7 percent for each 10 percent of additional land protected by adequate conservation measures. The draft report of the National Commission on Water Quality estimates that if land conservation measures are applied to

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14/ Since recreation estimates are tied to population estimates based on forecasted levels of coal-related development, the analysis shows requirements under the "low", "most probable", and "high" Harza scenarios.

Table IV-15. Need for Surface Acres Related to Alternative Outdoor Recreation Requirements, Upper Yellowstone, Montana

Activity	LOW			MOST PROBABLE		HIGH	
	1975	1985	2000	1985	2000	1985	2000
Swimming (Beach)	18 WSA[2/] 40 LSA	24 WSA 53 LSA	27 WSA 58 LSA	24 WSA 53 LSA	27 WSA 59 LSA	24 WSA 53 LSA	28 WSA 60 LSA
Water Skiing	3,495 WSA 13 LSA	4,435 WSA 17 LSA	5,329 WSA 20 LSA	4,477 WSA 17 LSA	5,473 WSA 20 LSA	4,494 WSA 17 LSA	5,552 WSA 21 LSA
Fishing[1/]							
Picnicking	269 A	378 A	503 A	382 A	517 A	384 A	525 A
Nature Walks	432 A	571 A	723 A	577 A	742 A	579 A	753 A
Boating/Canoeing	2,523 WSA 47 LSA	3,377 WSA 62 LSA	4,336 WSA 80 LSA	3,409 WSA 63 LSA	4,453 WSA 82 LSA	3,422 WSA 63 LSA	4,517 WSA 83 LSA
Hunting[1/]							
Camping	321 A	522 A	763 A	529 A	789 A	532 A	803 A
Hiking	422 A	542 A	662 A	547 A	680 A	549 A	690 A
Playing Games/Sports	170 A	233 A	307 A	235 A	315 A	236 A	320 A
Winter Sports	6 ISA 20 SSA	7 ISA 25 SSA	8 ISA 29 SSA	7 ISA 25 SSA	8 ISA 30 SSA	7 ISA 25 SSA	9 ISA 30 SSA

1/ Data not provided.

2/ Numbers followed by abbreviation "A" indicate Land Surface acres.
LS = Land Surface. WS = Water Surface. IS = Ice Surface. SS = Snow Surface. A - Acres.

Source: Bureau of Outdoor Recreation.

all of the Nation's farmland, a 50 percent reduction in stream sediment loads could be achieved--as well as a related reduction in pesticides and nutrients that cling to the soil particles and are carried back into the water-ways.

Soil and land conservation is an ongoing process; and many problems reoccur as time passes. Old conservation methods may be replaced by new ones; new problems replace old problems due to nature or manmade changes and as structural controls wear out or become obsolete. Erosion, from any cause, is a dynamic process and requires constant surveillance and corrective action.

The land conservation status, for 1975, on non-Federal land was developed by the Soil Conservation Service (SCS). Its task was accomplished by updating the 1967 Conservation Needs Inventory. The land conservation status for 1975 on most Federal land was developed by the Bureau of Land Management (BLM) and the Forest Service (FS). In addition, each of the two agencies estimated the 1985 and 2000 land conservation needs by analyzing trends from ongoing land conservation programs.[15/]

Land conservation measures were separated into two categories: (1) management only and (2) management--vegetative and mechanical. Management practices that are needed on irrigated land include the proper application of irrigation water, crop-residue management, proper cropping systems, and maintenance of fertility. Some or all of these practices are needed on the remaining portion of the irrigated land. In addition, mechanical measures such as land leveling and smoothing, the installation of drainage ditches, and the improvement of on-farm distribution systems are needed on some lands. A more recent measure is the conversion from flood to sprinkler irrigation which improves water conservation. Costs were developed by the SCS for non-

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15/ See Land Conservation Measures, Ad Hoc Work Group on Updating Land Conservation, May, 1977.

Federal lands and by BLM and FS for Federal lands.

Currently, 4,412,590 acres (74 percent) of total lands are adequately treated in the Upper Yellowstone Planning Area.16/ This includes 1,372,590 acres located on Federal lands and 3,040,000 acres on non-Federal lands.

Table IV-16 illustrates the need for increased land conservation measures on Federal and non-Federal lands in the planning area. A significant need for land conservation is tied to private croplands (irrigated as well as non-irrigated). Non-Federal and Federal rangeland also would appear to benefit from increased conservation measures.

In determining the projected requirements for land conservation, it has been assumed that they include all land not now classified as adequately treated. For this reason, the projected requirements are the same for both 1985 and 2000. As of 1975, it is estimated that there were 1,514,000 acres that still needed the application of some land conservation measures before they could be considered as adequately treated. The total estimated cost to install this treatment is $59,840,000.

Fish and Wildlife

Degradation of Habitat

Cutthroat trout and mountain whitefish are the only native salmonid species found in the Yellowstone River or its tributaries. Introduction of rainbow trout, brown trout, eastern brook trout, and golden trout (in alpine lakes) has provided an excellent fishery to replace populations of the native cutthroat trout which have declined through time due to deteriorated water quality or quantity in most streams.

Loss or degradation of fish habitat due to: (1) pollution from mining

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16/ Land on which the conservation measures essential to its sustained use have been applied.

Table IV-16. Projected Land Conservation Requirements, Upper Yellowstone, Montana

Land Use and Ownership	Acres	Dollars[1/]
Non-Irrigated Cropland	262,000	14,410,000
Federal	0	0
Non-Federal	262,000	14,410,000
Irrigated Cropland	185,000	40,149,000
Federal	0	0
Non-Federal	185,000	40,149,000
Non-Irrigated Pasture	45,000	725,000
Federal	0	0
Non-Federal	45,000	725,000
Irrigated Pasture	36,000	360,000
Federal	0	0
Non-Federal	36,000	360,000
Range	864,100	6,422,000
Federal	86,100	3,078,000
Non-Federal	778,000	3,344,000
Forest-Commercial	24,600	880,000
Federal	1,600	245,000
Non-Federal	23,000	635,000
Forest-Non-Commercial	98,000	403,000
Federal	11,000	186,000
Non-Federal	87,000	217,000
Other	0	0
Federal	0	
Non-Federal	0	
Total	1,514,000	59,840,000
Federal	98,700	3,509,000
Non-Federal	1,416,000	56,331,000

1/ Based on 1975 costs.

activities, sewage, or industrial wastes; (2) dewatering; and (3) siltation caused by overgrazing, poor logging practices, or irrigation return flows is a continuing problem. Stream channelization and rip-rapping also contribute to the destruction of the free-flowing aquatic habitat.

In the Upper Yellowstone Planning Area, projected mining exploration and exploratory activity in the Stillwater Complex may threaten area streams. An increase in human population related to mining may cause increased degradation of aquatic habitat in the area.

Access Sites

The majority of the area's streams, especially at lower elevations,are bordered by private lands. Lack of public access is becoming a major problem as more landowners limit or deny trespass across their property; some of the stream segments that are accessible are receiving extreme fishing pressure. Regional fisheries managers in the Upper Yellowstone Area have identified stream reaches where they consider fishing pressure to be at a maximum: (1) Big Creek--for two miles in the vicinity of the campground; (2) Stillwater River--46.3 miles from the mouth; (3) Fishtail Creek--11.5 miles from the mouth; and (4) West Rosebud Creek--7.8 miles above the national forest boundary.

There are other streams that receive little fishing pressure. It is an objective of the Montana Department of Fish and Game to spread the fishing pressure over more waters rather than to concentrate on campgrounds or access sites. This would necessitate the development of additional access sites.

The area fisheries managers recommend that any potential access sites that become available should be acquired. Ideas for specific sites are: (1) near Carter's Bridge south of Livingston on the Yellowstone; (2) near Springdale on the Yellowstone; (3) at the Marshall Ranch on the Stillwater;

and (4) at the Lionhead Ranch on the Boulder River. In addition, the State school lands, as well as National Resource Lands, that border area streams could provide additional access.

The fisheries managers also appear to be generally in favor of offstream storage reservoirs that would be designed and developed primarily for fisheries and related recreation. Operations of these projects would include maintenance of instream flows in conjunction with minimal drawdowns.

Increase in Resource Use

Table IV-17 shows the present use of streams in the Upper Yellowstone Planning Area. Easily accessible flatwater fisheries total nearly 1,600 acres with a potential of 25,000 fishermen days. Most lake fishing is not easily accessible but provides a quality wilderness fishing experience to those equipped to take advantage of the opportunity.

Table IV-17. Upper Yellowstone Fisheries, 1975

Water Type	Quantity	Fisherman Days	Resident Fishermen	Non-Resident Fishermen
Salmonid Streams	944.5 miles	214,045 1/		
Non-Salmonid Streams	91.5 miles	4,575 2/		
Lakes and Reservoirs	4778 acres	40,332		
		258,952	24,013 3/	9,428 3/

1/ Average catch rate of one fish per day.
2/ Average of 50 man-days per mile.
3/ Numbers of resident and non-resident fishermen are estimates of those who bought fishing licenses in the Planning Area.

The Montana Department of Fish and Game expects the numbers of sportsmen to more than double by the year 2020.

CHAPTER V

FUTURE WITHOUT (F/WO) AND REMAINING NEEDS

The future "without" a plan (F/WO) is that level of assumed development that is expected to be initiated and carried through by the private sector and on-going public programs. No new State and/or federally assisted developments are included when determining the F/WO.

The F/WO gives the State Study Team a place to begin its planning effort. If the F/WO meets all of the projected needs, then there is no need to plan for further development, but there may be a need to plan for reduced production. On the other hand, if there are remaining needs beyond the F/WO, the Study Team may want to support development by recommending additional State and/or Federal projects designed to satisfy or mitigate the remaining needs.

The objectives above also apply to environmental needs (e.g. the need to maintain or enhance instream flows)--the process is identical.

Agriculture

Nonirrigated Cropland

In examining trends in nonirrigated cropland, the Agricultural Ad Hoc Work Group summed historical harvested acres and performed a correlation analysis on the data to see if a significant trend existed over time. None of the planning areas in Montana exhibited statistically significant increasing trends for nonirrigated harvested croplands.[1/] Based on that analysis, the group projected that the number of nonirrigated acres would hold constant at their base value.

1/ See Agricultural Projections and Supporting Data, Agricultural Ad Hoc Work Group, February, 1977.

Given the above analysis and assumptions, it appears that nonirrigated agriculture will be able to supply (through increases in productivity) some of the roughage called for by the Ad Hoc Group's "third" projections (see Chapter IV). However, most of the future agricultural production, needed to mitigate or satisfy the projected requirements shown in Chapter IV, will come from irrigated cropland.

Irrigated Cropland

The Montana State Study Team has set the F/WO increase in irrigated acreage in the Upper Yellowstone Planning Area at the rate of 1250 acres per year--through the year 2000.2/ Table V-1 compares base year irrigated acreages with the F/WO, the OBERS projections (E and E'), and the "third" projections (3E and 3E').

Table V-1. Comparison of Alternative Irrigated Acreages, Upper Yellowstone, Montana

Situation	Acres	
	1985	2000
OBERS E	155,295	155,596
OBERS E'	158,299	158,810
Base Year	175,446	175,446
F/WO	188,000	206,750
3E	383,863	411,749
3E'	358,584	441,656

Differences between the F/WO, and the OBERS and "third" projections are shown in Table V-2. The differences are shown in terms of surpluses (+) or shortages (-) in needed irrigated acres and defined as remaining needs.

The entries given in Table V-2 illustrate the differences between the OBERS projections and the "third" projections (see the section on Irrigated Cropland in Chapter IV). Surplus acres occur when comparing the F/WO with the

2/ Montana State Study Team Minutes, July 26-27, 1977.

Table V-2. Surpluses and Remaining Needs Related to the F/WO, Upper Yellowstone, Montana

Situation	Acres	
	1985	2000
OBERS E	+ 39,205	+ 67,404
OBERS E'	+ 36,201	+ 64,190
3E	-189,363	-188,749
3E'	-164,084	-218,626

OBERS projections; they simply mean that according to OBERS the Upper Yellowstone will be producing on more acres than needed under the F/WO assumptions. In short, the OBERS projections are pessimistic. The remaining needs for new irrigated acres are shown by the negative values in the table; they reflect the need for additional roughage associated with the OBERS forecasts of increases in beef cattle production. At best, the values shown in Table V-2 may be considered merely to be indicators of the limits of future needs.

Saline Seeps and Irrigation Salinity

Areas of saline seep associated with non-irrigated croplands and irrigation salinity appear to have been increasing over the past several years (see Chapter IV for additional information). However, the F/WO status of saline lands cannot be determined because no data exist that accurately show the trend toward increasing amounts of saline lands; one estimate of the rate of increase in these lands has been 10 percent per year, which seems inordinantly high. The greatest problem is the emergence of saline seeps; however salinity problems associated with irrigation are now being documented and appear to be increasing.

Municipal, Industrial, and Livestock Water

It is assumed that all of the water needed for municipal, industrial, non-energy mineral, and livestock uses will be developed in the without situation. In other words, no matter what the level of development that is forecast for these users, the nature of that development is such that no SRD or NED projects will be needed to support it. The need for water by these users is relatively small, and they will be able to appropriate their own water at any foreseeable level of development. Therefore, there are no remaining needs beyond the F/WO. Table IV-3 illustrates projected water consumption by such users in the Upper Yellowstone Planning Area.

Table V-3. F/WO Municipal, Industrial, Non-Energy Mineral, and Livestock Consumptive Water Needs

	af/y		
	Base	1985	2000
Municipal 1/	6,798	8,163	9,100
Industrial 2/	8,700	9,400	10,700
Non-Energy Minerals 3/	37	52	139 5/
Livestock 4/	12,700	13,500	15,600
Totals	28,235	[illegible]	35,539

1/ Based on most probable level of energy development. See F/WO energy section in the Tongue-Powder or Lower Yellowstone Reports.

2/ Based on Bureau of Domestic Commerce data.

3/ See Non-Energy Mineral Water Needs, Ad Hoc Group on Updating Minerals Data, May, 1977.

4/ Derived from F/WO Livestock Projections.

5/ Mining and related activities in the Stillwater Complex.

Flood Control

The Flood Control Ad Hoc Group, in updating flood damages, assumed the

current trends toward increased flood plain regulation would continue into the future. The group assumed also that no additional structural measures would be added to mitigate flood damages. Therefore, the F/WO is represented by the projected requirements shown in the section on flood control in Chapter IV (See Table IV-12). Table V-4 reintroduces the projected requirements as remaining needs, given no structural F/WO solutions for the Tongue-Powder Planning Area.

Table V-5 depicts the remaining needs for the control of streambank erosion; again no structural solutions are taken into account. The table reintroduces Table IV-13 of Chapter IV.

Indian Water Requirements

At the present time, the water requirements of the Crow and Northern Cheyenne Indian Tribes are unknown. The tribes have been advised not to participate in the Level B Study so as not to prejudice existing and pending litigation concerning the use of water on and adjacent to the two Indian reservations.

However, rather than ignore Indian resources and potentials on tribal lands, the Level B Study considered tribal resources and potential projects (e.g., the Pryor Creek Project) that were known and treated them in the same manner as those that are found off of the reservations. On this basis no separate F/WO was formulated to account for or estimate Indian water requirements.

Energy

Since coal-related energy development is not forecasted to occur in this planning area, no F/WO situation (aside from population impacts) was developed for the Upper Yellowstone. The reader is referred to this section

Table V-4. Flood Damage Remaining Needs, Upper Yellowstone, Montana[1/]

Stream and Reach	Area Subject To Flooding	Flood Damages 1975	1985	2000
	(1,000 acres)	($1,000)		
Yellowstone River				
Wyoming Line to Billman Creek	3.0	15	16	17
Billman Creek to Clarks Fork	36.8	315	331	354
Clarks Fork to Bighorn River	40.0	481	505	541
Shields River				
Horsefly Creek to Mouth	3.5	18	19	20
Boulder River				
West Boulder Creek to Mouth	1.4	9	9	10
Stillwater River				
West Fork to Mouth	2.0	16	17	18
Upper Yellowstone Tributaries	*63.6*	*1,461*	*1,753*	*2,484*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table V-5 Streambank Erosion Remaining Needs,
Upper Yellowstone, Montana

Main Stems	Annual Damages 1975	1985	2000
		($1,000)	
Upper and Lower Yellowstone Planning Areas			
Yellowstone River	217	338	382
Main Tributaries 1/	85	133	150
Upper and Lower Clarks Fork and Bighorn Planning Areas			
Clarks Fork River	32	49	56
Bighorn River	291	453	511
Upper and Lower Tongue and Powder Planning Areas			
Tongue River	55	85	96
Powder River	140	217	245
Montana Tributaries 2/			
Yellowstone, Clarks Fork, Bighorn, Tongue, & Powder Rivers	61.5	95.7	108.1
Little Missouri River	7.8	12.1	13.6
Totals	69.3	107.8	121.7

1/ Drainages of more than 400 square miles.

2/ Drainages of less than 400 square miles.

in the Lower Yellowstone and Tongue-Powder Planning Area Reports for the F/WO and remaining needs related to coal development in Eastern Montana.

Outdoor Recreation

Although private enterprise can (and does) provide some measure of water-based outdoor recreation in the Yellowstone Basin, the extent of the industry is not known at this time. A F/WO has not been specifically formulated for outdoor recreation so it must be assumed that the projected requirements also represent the remaining needs. The needs are tied directly to population. Table V-6 shows the needs based on the "high" and "most probable" levels of development of the coal industry. The "most probable" is included because it represents the F/WO situation of coal-related development.

Land Conservation

It is reasonable to assume that land conservation measures will continue to be implemented in the F/WO situation through ongoing Federal programs. Table V-7 shows the F/WO and the remaining needs for the Tongue-Powder Planning Area, given continuation of existing and ongoing land conservation programs.

Figure V-1 further explains Table V-7 by illustrating land conservation status over time and by ownership and use. Private range and nonirrigated cropland appear to have the greatest need for land conservation treatment.

Fish and Wildlife

According to a draft of the Montana Department of Fish and Game's Strategic Plan, a surplus of salmonid, non-salmonid, and waterfowl popula-

Table V-6. Remaining Needs for Outdoor Recreation, Upper Yellowstone, Montana1/

Activity	Most Probable 1985	Most Probable 2000	High 1985	High 2000
Swimming (Beach)	24 WSA 53 LSA	27 WSA 59 LSA	24 WSA 53 LSA	28 WSA 60 LSA
Water Skiing	4,477 WSA 17 LSA	5,473 WSA 20 LSA	4,494 WSA 17 LSA	5,552 WSA 21 LSA
Fishing2/				
Picnicking	382 A	517 A	384 A	525 A
Nature Walks	577 A	742 A	579 A	753 A
Boating/Canoeing	3,409 WSA 63 LSA	4,453 WSA 82 LSA	3,422 WSA 63 LSA	4,517 WSA 83 LSA
Hunting2/				
Camping	529 A	789 A	532 A	803 A
Hiking	547 A	680 A	549 A	690 A
Playing Games/Sports	235 A	315 A	236 A	320 A
Winter Sports	7 ISA 25 SSA	8 ISA 30 SSA	7 ISA 25 SSA	9 ISA 30 SSA

1/ Estimates of outdoor recreation needs were obtained by subtracting supply from demand. For further explanation see Outdoor Recreation Update, Upper Yellowstone Planning Area, Recreation Ad Hoc Group, May, 1977.

2/ Data not furnished for Level B Study.

LS = Land Surface. WS = Water Surface. A = Acres. IS + Ice Surface.
SS = Snow Surface

Table V-7. F/WO and Remaining Land Conservation Needs on Federal and Non-Federal Lands, Upper Yellowstone, Montana1/

Need	Acres		
	1975	1985	2000
Adequately Treated:			
Non-Federal	3,040,000	3,324,000	3,594,000
Federal	1,372,590	1,423,390	1,439,490
Total Adequately Treated	4,412,590	4,747,390	5,033,490
Remaining Needs:			
Non-Federal	1,416,000	1,132,000	862,000
Federal	98,700	47,900	31,800
Total Remaining Needs	1,514,700	1,179,900	893,800

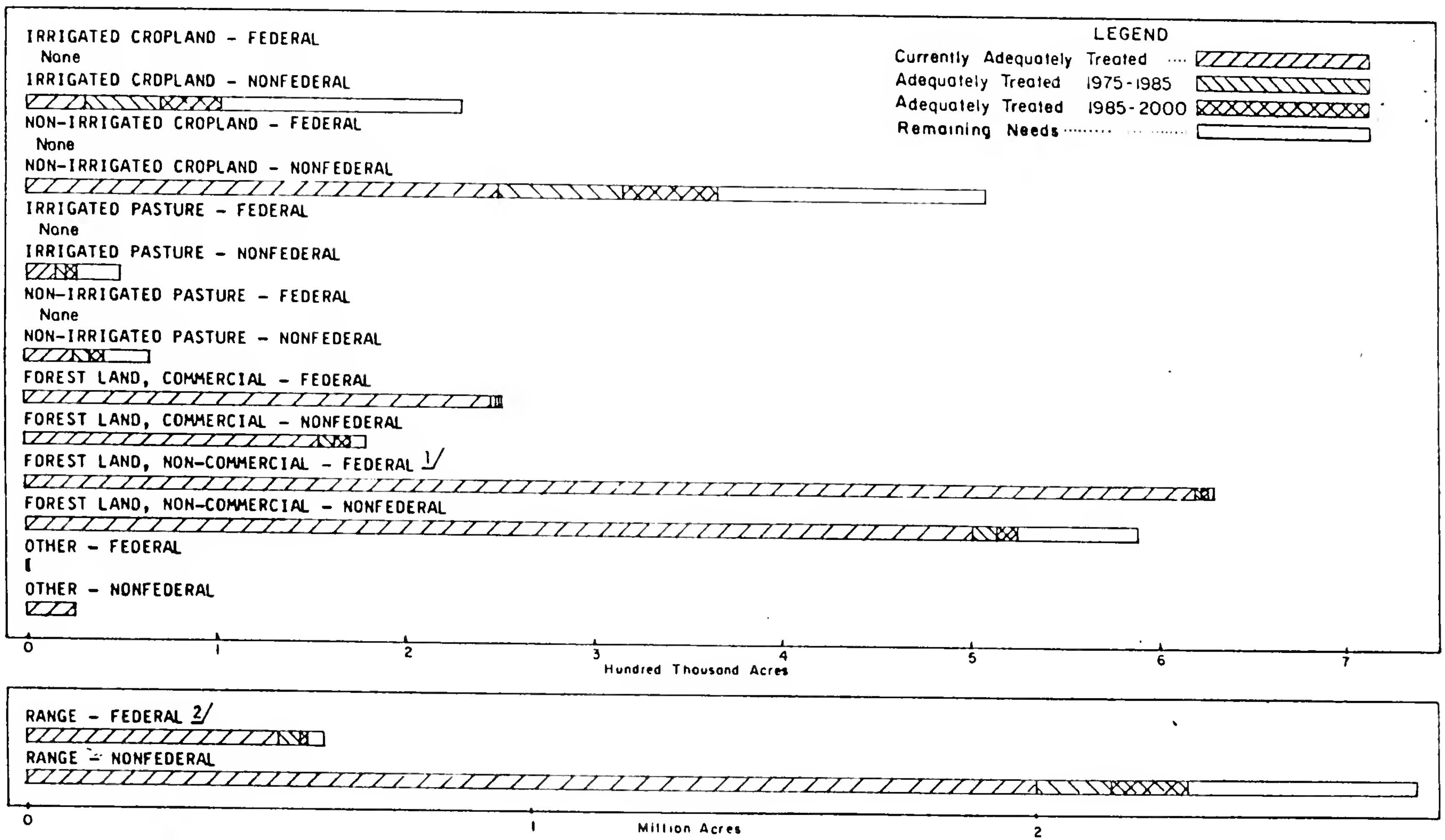
1/ Estimates for Federal lands were made by the Bureau of Land Management and Forest Service. The Soil Conservation Service developed the estimates for non-Federal lands. Each Agency developed the 1985 and 2000 F/WO projections by analyzing the trends from ongoing conservation programs.

tions will exist throughout the Yellowstone Area at least to the year 1982; projections of supply and demand beyond this point do not exist. However it is probably safe to say that, due to probable degradation of habitat in the future, the supply of harvestable wildlife will not increase to meet future demands by hunters and fishermen.

In general, the F/WO is affected by four factors: (1) continuing degradation and loss of habitat; (2) lack of access; (3) a fixed supply; and (4) increasing demand. It is unlikely that the private sector will enter the fish and wildlife business (e.g., big game ranches, private waterfowl and fishing developments) until shortages become apparent and encourage profitable entry. Therefore, until 1982 the remaining needs may be measured as a surplus and private entry into the fish and wildlife industry is not expected. However, the loss and degradation of habitat, as well as limited access to sportsmen, have to be accounted for in a different manner; thus

Figure V-1. Land Conservation Status,
Upper Yellowstone, Montana

April 1977



1/ Includes all BLM forest land as non-commercial
2/ Barren land and tundra are included in range

the remaining needs related to habitat and access must be recognized as a shortage.

F/WO Impacts on Water Quantity and Quality

The impact of F/WO development on the area's water resources is shown in the Hydrology Supplement which is appended to the report. The Hydrology Supplement is discussed in greater detail in Chapter VII.

Opportunities

In order to meet the remaining needs as they were presented earlier in this chapter, various State and Federal agencies proposed various projects and programs to the State Study Team for consideration. These projects and programs comprised the total set of elements that were considered for the National Economic Development (NED) plan, the Environmental Quality (EQ) plan, and the State/Regional Development (SRD) elements that follow in Chapter VI, and later in the Recommended Plan of Chapter VII. Some of the following projects and programs were not accepted by the Study Team and were eliminated from further consideration, as shown in the footnotes.

Multipurpose Projects

	Source	New Irrigated Acres	Supplemental Irrigated Acres
1. Flathead Creek	SCS	1,000	4,000
2. Sweet Grass Creek	SCS	4,500	10,400
3. East Rosebud Creek	SCS	1,536	1,670
4. Pryor Creek South	SCS	2,600	1,600

Single Purpose Projects

	Source	New Irrigated Acres
1. White Horse Bench	USBR	2,000
2. Huntley South	USBR	3,840
3. Seven Mile - Sitting Bull	USBR	4,808 1/

1/ In addition, 1,700 acres now irrigated will be converted to service from the new system.

Single Purpose Projects (continued)

		Source	New Irrigated Acres
4.	Six Mile Creek3/	USBR	4,440
5.	Eight Mile Creek	USBR	4,350
6.	Livingston South	USBR	7,580
7.	Livingston North	USBR	2,460
8.	Carney Flats	USBR	2,390
9.	Airport Flat and Kellogg Bog	USBR	5,620
10.	Millikan	USBR	2,425
11.	Greycliff West	USBR	1,720
12.	Falgren Gulch	USBR	1,100
13.	Bridger Creek	USBR	1,150
14.	Cove Unit	USBR	3,137
15.	Bitter Creek	USBR	2,590
16.	Pryor Creek North	USBR	2,380
17.	Huntley Extensions	USBR	1,788

Flood Control

		Source	Protected Acres
1.	West Billings Diversion	COE	2,080
2.	Livingston Levee4/	COE	300

Land Conservation

		Source	Treated Acres
1.	Accelerated Land Conservation Program	USFS, BLM, SCS	446,900
2.	Streambank Greenbelt Program	State Study Team	Not Available
3.	Rehabilitation of the Headwater of the Shields River	State Study Team	Not Available

Fish and Wildlife

		Source
1.	Removal of Fish Spawning Barriers to Tributaries of Yellowstone River	State Study Team
2.	Improvement of the Flow Regimen of Tributaries of Yellowstone River above Livingston	State Study Team

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3/ The single purpose projects including Six Mile Creek and those that follow (nos. 4-17) were rejected by the State Study Team because they could not meet either National Economic Development or State/Regional Development criteria (i.e., in this case a benefit/cost ratio of .85). Additional information about these projects may be obtained from the U.S. Bureau of Reclamation, Billings, Montana.

4/ This project was dropped because it failed to meet NED criteria. Additional information about this project may be obtained from the U.S. Army Corps of Engineers in Omaha, Nebraska.

Fish and Wildlife (continued)

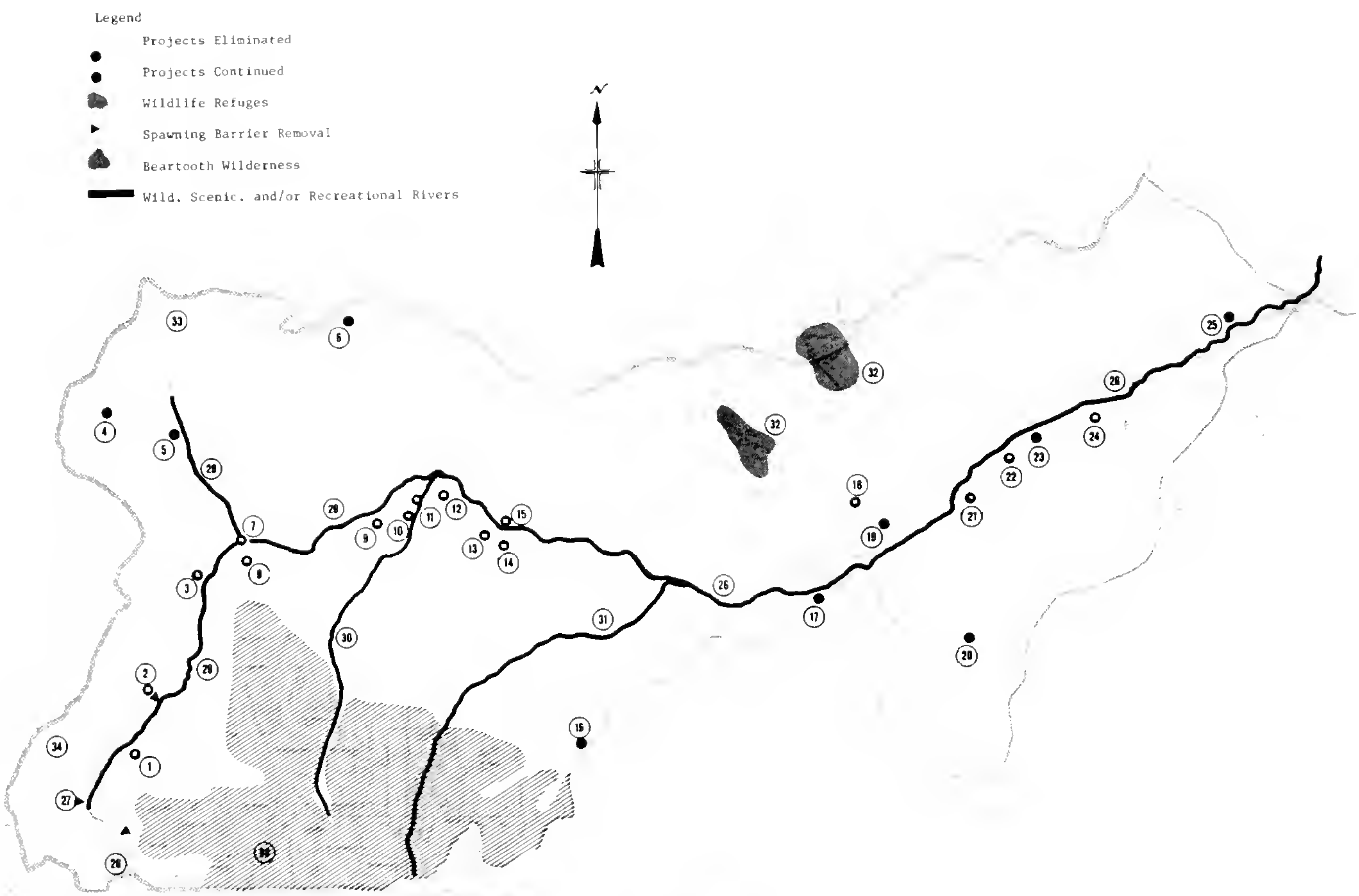
	Source
3. Antelope Creek Storage to Maintain Late Season Instream Flows in the Shields River	State Study Team
4. Management of Yellowstone River Islands to Improve Goose and Other Wildlife Habitat	State Study Team
5. Develop Wheat Basin and Broadview Wildlife Refuges	State Study Team
6. Classify the Beartooth and Absaroka Primitive Areas	State Study Team
7. Sweet Grass Creek Storage to maintain Late Season Instream Flows in Sweet Grass Creek	State Study Team
8. Support the Instream Flow Recommendations Made by the Montana Departments of Fish and Game, and Health and Environmental Sciences5/	DFG and DHES

Wild, Scenic, and Recreational Rivers

	Source
1. Yellowstone River - 225 miles - National System	BOR
2. Boulder River - 58 miles - State System	BOR
3. Shields River - 40 miles - State System	BOR
4. Stillwater River - 65 miles - State System	BOR

5/ See the section on the Yellowstone Moratorium in Chapter II, the Instream Flow section in Chapter IV, and the EQ plan of Chapter VI for additional information.

PLATE V-1 LOCATION OF PROPOSED PROJECTS AND PROGRAMS (OPPORTUNITIES),



YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

1. Six Mile Creek Unit
2. Eight Mile Creek Unit
3. Livingston Levee
4. Flathead Creek
5. Antelope Creek
6. Sweet Grass Creek
7. Livingston North Unit
8. Livingston South Unit
9. Carney Flats Unit
10. Airport Flat Unit
11. Kellogg Bog Unit
12. Milliken Unit
13. Greycliff West Unit
14. Bridger Creek Unit
15. Falglen Gulch Unit
16. East Rosebud
17. Whitehorse Bench Unit
18. Core Unit
19. West Billings Diversion
20. Pryor Creek (SCS)
21. Bitter Creek Unit
22. Pryor Creek (USBR) Unit
23. Huntley South Unit
24. Huntley Extensions Unit
25. Seven Mile - Sitting Bull Unit
26. Yellowstone River Wild/Scenic
27. Spawning Barrier Removal
28. Beartooth Wilderness Unit
29. Shields River Scenic/Recreational
30. Boulder River Scenic/Recreational
31. Stillwater River Scenic/Recreational
32. Broadview-Wheat Basin Wildlife Refuges
33. Rehabilitation of Shields Headwater Basin
34. Flow Regimen Improvement
35. Yellowstone River Islands (area-wide)
36. Accelerated Land Conservation Program (area-wide)
37. Streambank Greenbelt Program (area-wide)
38. Minimum Instream Flows (area-wide)

CHAPTER VI

PLAN FORMULATION

Principles and Standards

Criteria used for the evaluation of projects and formulation of the alternative plans set forth later in this chapter are those established under the multi-objective planning (MOP) approach of the U.S. Water Resources Council. Planning guidelines for the Yellowstone Level B Study conform with the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources, as published in the Federal Register of September 10, 1973.

Alternative plans for resource development and/or management for the Montana planning areas have been formulated to emphasize national economic development (NED), and environmental quality (EQ). A third, but partial, plan emphasizing state/regional development (SRD) has been included to identify projects that produce substantial local or regional benefits but that do not meet NED criteria. A fourth plan, called the Recommended Plan, is a combination of those projects or programs selected from the NED, EQ, and SRD plans that best meet the remaining needs outlined in Chapter V.

Plan formulation for the NED and SRD emphasis plans is tied primarily to the monetary benefit, cost and repayment evaluation of potential projects or programs (elements). The formulation criteria for retaining an element in the NED or SRD plan are that the results of the economic and financial appraisal of that element must show that user benefits exceed costs and that there is an apparent source of repayment of project costs. EQ plan formulation criteria do not relate to rigid economic standards but emphasize

enhancement, preservation, or management as the principal objectives. A combination of selected elements from the NED, SRD, and EQ plans makes up the recommended resource development and/or management plan for the Yellowstone Basin area; each of the four plans is described in more detail later in this chapter.

The beneficial and adverse effects of a proposed development are evaluated for the period of the useful life of the major project facilities, with an upper limit of 100 years. A discount rate of 6-3/8 percent has been used for the Yellowstone study. Benefits and costs occurring in different time frames over the period of analysis have been adjusted to comparable values by the use of the 6-3/8 percent discount rate. All costs and benefits are based on January 1975, prices.

The Four-Account System

Under the MOP procedures, each plan, regardless of which objective (e.g., NED, EQ, or SRD) is emphasized, is evaluated and displayed in terms of a four-account system--national, regional, environmental, and social factors accounts. This means that each project or program that is proposed for consideration in any of the plans is evaluated under the four-account system also.

Benefits and costs for the national and regional accounts are expressed as monetary values but also include a descriptive analysis of beneficial and adverse effects. For the other two accounts--environmental and social factors--the main emphasis is in identifying and evaluating changes that would occur with a plan and describing in a succinct narrative the beneficial or adverse effects associated with the changes. A simplified display chart of the plans and accounts follows:

	Alternative Plan			
	NED	SRD	EQ	Recommended
National Economic Development Account				
Benefits	$	$	$	$
Costs	$	$	$	$
State/Regional Development Account				
Benefits	$	$	$	$
	(-----Descriptive terms-----)			
Costs	$	$	$	$
	(-----Descriptive terms-----)			
Environmental Quality Account				
Beneficial effects	(-----Descriptive terms-----)			
Adverse effects	(-----Descriptive terms-----)			
Social Factors Well Being Account				
Beneficial effects	(-----Descriptive terms-----)			
Adverse effects	(-----Descriptive terms-----)			

National Economic Development Account

Benefits evaluated under the national account are direct user benefits. User benefits are displayed for the traditional project multipurposes of irrigation, flood control, recreation, fish and wildlife, M&I water, power, etc. User benefits are measured as net income increases, damage reductions, or proxy values of alternative actions to direct project beneficiaries. Income increases may include the net increases in salaries or persons who actually work on the project during construction or operation, and who would be unemployed or underemployed in the absence of the project. Benefits may not include second-level effects such as income to businesses resulting from the project. National account costs are measured as the economic values placed on the resources required to implement a plan and place it in operation.

State/Regional Development Account

Benefits and costs evaluated under the regional account are delineated for incidence of occurrence within the boundaries of the Montana study area. These local effects generally are offset by their effects on the "rest of the

Nation," because they would have occurred elsewhere had the expenditures for the project been made elsewhere.

Regional monetary benefits are estimated for four income categories: user benefits, induced and stemming from effects, construction inpacts, and unemployment and underemployment effects. User benefits are defined the same as for the national account.

Induced and stemming effects are estimated as the income generated from implementing plan services that are in addition to user benefits. Construction impacts are estimated as the income increase accruing to the region from wage payments to imported labor forces during the construction period. Income increases to the unemployed and underemployed persons in the region are estimated as portions of the preceding two categories--induced and stemming effects and constructions impacts--and are assumed to be significant only during the early years of project life.

Local costs include local payments toward construction and operation, and regional tax contributions. Both adverse and beneficial effects, not evaluated monetarily, are to be measured in appropriate terms, described, and displayed in the local account.

Environmental Quality Account

A water and land use plan may have a variety of effects--beneficial and adverse--on the environment. While monetary effects do occur, effects on the environment are generally characterized by their non-market, non-monetary nature.

Environmental effects are contributions resulting from the management, preservation, or restoration of one or more of the desirable environmental characteristics of an area under study. Adverse environmental effects are consequences of proposed actions that result in the deterioration of environmental characteristics of an area.

Social Well Being Account

Beneficial and adverse effects on social factors are derived from a plan's success or failure in meeting social needs. The identification and satisfaction of social needs will relate to the social deficiencies expected to prevail in the study area without a plan as compared to the expected changes, social gains, or losses, with a plan.

The MOP guidelines for evaluating social factors were written to emphasize the effects on those users of projects or programs who have, without the project or program, failed to share in rising economic standards. This would seem to focus on the unemployed or underemployed persons which according to regional benefit evaluation criteria would be significant only during the early years of project life because of the assumed long-range, full employment situation nationally.

Procedures are not available to measure the social status of future beneficiaries. Opportunities for improving social status are available through implementation of resource development; however, documentation of the actual benefiting social group is not possible. Social effects are, therefore, evaluated and displayed only for the projects and programs that are included in the alternative plans, and are not considered as an end in themselves.

Display of Data

In order to provide consistency in the display of information for various projects and programs that have been analyzed, data have been set forth in the general format suggested. In some cases, the form itself has been used, in other cases, separate sheets have been used for each account, but the arrangement and coverage is the same in either case.

Project Formulation

When data for a project or program that has been suggested for inclusion in the planning area has been evaluated and tabulated under the four-account system, it is then possible and necessary to test the proposal in terms of its acceptabilities for inclusion in the various "objective" plans--National Economic Development (NED); State/Regional Development (SRD); and Environmental Quality (EQ). Each of these plans has specific requirements that must be met if a project or program is to be included in that plan, and to the extent that this is so, the proposal's attractiveness for inclusion in the Recommended Plan is enhanced. The Recommended Plan is a selection of those components of the other three plans that best satisfy the needs identified in Chapter V. No project or program may be included in the Recommended Plan unless it has qualified for at least one of the three objective plans.

Summary--Upper Yellowstone Planning Area

National economic development (NED) emphasis in the planning area is tied to agriculture. Table VI-1 shows the agricultural projects proposed in the Upper Yellowstone. There are four Soil Conservation Service (SCS) multipurpose projects that are designed to provide for both full and supplemental irrigation. Two Bureau of Reclamation (USBR) single purpose irrigation projects are included also. The USBR proposals are mainstem pumping projects while the SCS has proposed storage projects on the tributaries.

No energy development has been forecast for the planning area whether it be extraction or electric generation. The area has potential thermal, geothermal, and hydroelectric potentials but such developments do not appear to be feasible by the year 2000.

The remaining NED proposal is a Corps of Engineers (COE) flood control project near Billings.

The lone SRD element is a USBR mainstem pumping project.

Environmental Quality (EQ) emphasis is on the designation of wild, scenic, or recreation rivers; the Yellowstone River has been recommended to be placed in the national system, while the Boulder, Shields, and Stillwater Rivers have been recommended for State designation. Several other EQ projects pertaining to land conservation and fish and wildlife are part of the EQ plan also.

Table VI-1. Agricultural NED and SRD Projects, Upper Yellowstone, Montana

NED Projects

Project	Source	Type	Irrigated Acres	
			Full	Supplemental
Flathead Creek	SCS	Storage	1,000	4,000
Sweet Grass Creek	SCS	Storage	4,500	10,400
East Rosebud Creek	SCS	Storage	1,536	1,670
White Horse Bench	USBR	Pumping	2,000	---0---
Pryor Creek	SCS	Storage	2,600	1,600
Huntley South Unit	USBR	Pumping	3,840	---0---
Totals			15,476	17,670

SRD Project

Project	Source	Type	Irrigated Acres	
			Full	Supplemental
Seven Mile-Sitting Bull Unit	USBR	Pumping	4,808 1/	---0---

1/ Water would also be supplied to 1,700 acres now irrigated. This 1,700 acres is included under "supplemental" figures in some tables.

THE

NATIONAL ECONOMIC DEVELOPMENT

PLAN

National economic development is achieved by increasing the value of the Nation's goods and services, by utilizing additional resources, or by improving the efficiency of existing resource use. Theoretically, the best NED plan would produce the maximum net benefits (excess of projected monetary benefits over monetary costs). A satisfactorily developed plan with NED emphasis would meet the following minimum requirements:

1. User benefits are in excess of total economic costs;
2. Separable costs of each functional component are less than benefits or the alternative cost of producing comparable benefits;
3. Sufficient capability is available to repay all reimbursable costs;
4. Significant local and State support is available; and
5. Output from the plan will be used to meet near-to-intermediate-term needs.

A project or program may not be included in the NED plan unless it meets, or is expected to meet, all of the above requirements at the time of development.

Multipurpose Projects

Flathead Creek

The headwaters of Flathead Creek arise in the area of Flathead pass in the northern part of the Bridger Mountains in the northeast corner of Gallatin County. Flathead Creek flows east to join the Shields River, which is a tributary of the Yellowstone River.

About 4,000 acres of irrigated land along this creek are short of late-summer and fall irrigation water and about 1,000 additional acres of dry cropland could be converted to irrigated cropland if spring runoff water were stored for irrigation.

There is sufficient excess snowmelt runoff to provide a full-season water supply for the irrigated and irrigable acres under the existing ditch

systems, provided it is stored for late-season use. There are two feasible storage sites--one onstream and the other offstream. Spring runoff at the storage and diversion sites amounts to 10,400 acre-feet at the 80 percent chance for the period from April 1 through June 15. Water quality is excellent with no problems with salts or sediments.

Structural development would include one onstream reservoir, one off-stream reservoir, a diversion structure, and 3.1 miles of canal to the off-stream reservoir. Delivery of water to irrigated land would be by existing canals and ditches. The onstream site is on Flathead Creek about one-half mile below the confluence of North, South, and Middle Forks in the SW-1/4 Sec. 28, T3N, R7E. Drainage area above the site is about 21 square miles. The off-stream site is in the SW-1/4 Sec. 18, T3N, R8E. Drainage area above the site is about 2 square miles. Total irrigation water stored in the two sites would be 8,340 acre-feet. The storage sites were selected because they have the best embankment-to-storage ratios of all the sites in the drainage and they are geologically sound.

Flathead Creek has good potential for development as a small watershed project for irrigation. There would be incidental flood prevention benefits and incidental recreation benefits that were not evaluated during this study.

Sweet Grass Creek

Sweet Grass Creek begins in the Crazy Mountains west of Melville in the northwest part of Sweet Grass County and northeast part of Park County. The creek flows southeasterly to join the Yellowstone River near Greycliff. There are about 18,600 acres now irrigated--all in Sweet Grass County--with 23,000 more acres that could be irrigated if water were available. There are two existing offstream reservoirs--Lake Adam, with 11,000 acre-feet and Lake Walvoord, with 14,000 acre-feet of storage that are operated by the Sweet Grass Canal and Reservoir Company. There are about 70 farms or parts

of farms in the watershed--most of which would benefit from the construction of additional water storage.

About 10,400 acres of land now irrigated out of Sweet Grass Creek are short of late-season water and thereby restricted from producing up to their potential. Another 4,500 acres of good irrigable land lie within or adjacent to existing canal and ditch systems. Irrigation of these acreages would improve the overall efficiency of the project by spreading fixed and maintenance costs over more acres.

There is sufficient surplus spring runoff water to supply the needs of these presently irrigated and some additional irrigable lands, provided it is stored for late-season and full-season use. There are two good, geologically sound storage sites with good storage embankment-to-capacity ratios. The soils have proven to be profitable to irrigate as evidenced by over 70 years of use, although the low permeability of some requires careful water management. The water quality is excellent for irrigation with no salt problems and very little sediment yield.

Structural development would include one onstream reservoir with a capacity of 24,600 acre-feet in Sec. 24, T5N, R12E northwest of Melville; one offstream reservoir near the two existing offstream reservoirs with a capacity of 2,400 acre-feet in Sec. 14, T3N, R15E; minor enlargement of 2.8 miles of existing feeder canal (diversion structure has adequate capacity); and about 20 miles of farm ditches as onfarm development. Surplus water is available for these storage sites, but land rights are the main deterrent at present.

Irrigation benefits would derive from supplying 10,400 acres with late-season water and from converting 4,500 acres of dry cropland to irrigation.

Land treatment measures can improve efficiencies of water distribution and onfarm irrigation, but cannot solve temporal (late-season) water shortages.

The storage sites that were evaluated were selected from among the alternatives on the basis of best storage capacity-to-embankment ratios for geologically sound dam sites.

Sweet Grass Creek has good potential for development as a small watershed project for irrigation. There would be incidental flood prevention and recreation benefits.

East Rosebud Creek

East Rosebud Creek starts high in the Beartooth Primitive Area south of Roscoe, flows in a northerly direction through Roscoe to join West Rosebud Creek 3 miles south of Absarokee, and flows into the Stillwater River near Absarokee. The Stillwater is a tributary of the Yellowstone River. Climate at the higher elevations limits crop production to hay, pasture, and small grains.

About 1,670 acres now irrigated out of East Rosebud Creek are short of water after mid-July, and another 1,536 acres of good irrigable lands can be developed with about 5 miles of extensions on existing ditch systems. Development of these resources is needed to improve the hay bases on about 20 ranches.

Average annual runoff from East Rosebud Creek measured near the reservoir site is about 142,000 acre-feet. Most of this flow comes before mid-July. The project would store only 15,000 acre-feet, thus ample water is available. There is a geologically sound dam site about one-quarter mile above the Weast Canal diversion, and borrow material is available within a reasonable haul distance. Soils now irrigated and to be irrigated are quite productive,with good internal drainage.

Structural development would include one onstream reservoir with 15,000 acre-feet of storage on East Rosebud Creek about one-quarter mile above the Weast Canal diversion in Sections 16 and 17, T6S, R18E. There would be

extensions of about 5 miles of onfarm irrigation ditches to serve some new irrigation. Storage at this site was determined to be the least costly alternative for solving the watershed's irrigation problems.

Land treatment measures could improve efficiences of water delivery and onfarm use but would not solve late-season water shortages or provide water for new irrigation development. An alternate to the proposed project might be the development of a much larger reservoir at the same location for power generation and irrigation of more acres in other watersheds as well as acreages in this project area. Water from this reservoir could replace storage in Cooney Reservoir if the Weast Canal were enlarged to deliver water to Volney Creek.

East Rosebud Creek has a good potential for development as a small watershed project for irrigation. There would be incidental flood prevention and recreational benefits that were not evaluated in this study.

Pryor Creek

The Pryor Creek watershed is located in Southcentral Montana. It lies in Big Horn and Yellowstone Counties. Pryor Creek arises along the north slope of the Pryor Mountains and flows north-northeast, discharging into the Yellowstone River near Huntley, Montana.

Agriculture is the main economic activity in the watershed and consists of cattle ranching and dry and irrigated farming. The major dryland crop is wheat and hay is the major crop irrigated with water diverted from Pryor Creek.

Farmers and ranchers have indicated real concern for protection from flood damage and supplemental irrigation water for lands along Pryor Creek. Flood damages are largely restricted to the lands along Pryor Creek, but streambank erosion is not a major problem.

There is no irrigation water storage at the present time, so shortage

of irrigation water becomes a major problem in the watershed during the peak use period of July and August. This seasonal shortage has curtailed the development of additional irrigable lands along Pryor Creek.

Structural and land treatment measures are needed to provide flood protection and irrigation storage. Irrigation storage is needed for development of additional irrigable lands along Pryor Creek and to provide late season supply for 1,600 acres of presently irrigated land. These presently irrigated lands also need improved irrigation systems and water management for better irrigation efficiencies.

A potential reservoir site that would meet the needs of the area around and above the town of Pryor has not been located. A good potential site exists on Pryor Creek about 9 miles downstream from the town of Pryor. The site is located near the center of the watershed area on a paved highway and within short travel distance from Billings making it easily accessible for recreation use. The reservoir would provide recreational opportunities for water sports, camping, and lake fishing. Additional irrigated areas could provide more cover and food supply for game birds such as pheasants, although it could aggravate poor water quality conditions in the lower streams.

There is adequate early season surplus water that can be stored for late season irrigation use and new irrigation development eight out of ten years. There are over 2,600 acres of land along Pryor Creek below the proposed dam site that could be developed for irrigation, much of it by extending present systems.

Most of the watershed is within the Crow Indian Reservation. The Crow Indian Agency has contracted with a private engineering firm to investigate all potential water development on the reservation. The Indians have the necessary water rights to develop irrigation projects.

Irrigation development would require 27.5 miles of new canals and associated structures; 3.2 miles of service laterals; and the enlargement of 8.3 miles of existing canals and associated structures.

The supplemental water for the existing irrigation would be released into Pryor Creek and then be diverted by existing systems.

Single Purpose Projects

Whitehorse Bench Unit

Whitehorse Bench is an old river terrace underlaid with gravel that lies near the confluence of the Yellowstone and Clarks Fork Rivers about two miles north of Silesia, Montana. Its surface is uneven and slopes gradually toward the confluence of the two rivers.

Rather complex gravity irrigation systems would be required and some leveling would be necessary. Most of the 2,000 acres in the unit is better suited to sprinkler irrigation than to gravity systems.

Water for the project would be pumped from the Yellowstone River at a rate of 40 cubic feet per second (cfs) and lifted 350 to the main canal. The discharge line would be 36 inches in diameter.

Huntley South Unit

The proposed Huntley South Unit is located in Yellowstone County to the south of the Yellowstone River and adjacent to the up-slope of the existing Huntley Canal. The unit extends along the Huntley Canal from the town of Huntley to the town of Ballantine.

The study area is comprised of ten separate parcels which total 5,100 arable acres. The parcels are transversed by the Lewis and Clark Trail and the Burlington Northern Railroad and numerous natural drainages.

The largest and least fragmented of the ten parcels lies between the Lewis and Clark Freeway and the Huntley South Canal. It has an area of

1,320 net irrigable acres. Most of the area above this parcel is quite small, fragmented by the freeway and numerous natural drainages.

The project would supply water to 3,840 net irrigable acres. The major features would include a main pumping plant; a relift plant at the westerly edge of the unit, serving 820 net irrigable acres with a static lift of 135 feet; and a relift plant at the easterly edge of the project serving 545 acres. Also included would be 45,200 linear feet of main canal, 41,000 linear feet of laterals, 25 drainage culverts under the main canal, and six lateral crossings of the freeway and railroad. About 25 percent of the area would not be provided with gravity service.

In estimating the cost for the drainage facilities for the project, it was assumed that parallel drains have been constructed to handle natural runoff upslope of the Huntley Canal, the Lewis and Clark Trail, and the Burlington Northern Railroads. For these drains, an improvement cost of a new drainage system was assumed.

Flood Control

West Billings Diversion

Canyon Creek which flows through the western portion of Billings has a history of flooding. In response to past and potential flooding, the Corps of Engineers has proposed to construct a diversion system parallel to Shiloh Road for 4.7 miles consisting of a conduit, channels, levees, and a drop structure which would protect nearly 2,100 acres and 60,000 residents.

Land Conservation

Accelerated Land Conservation Program

Under the accelerated land conservation program, 50 percent of the

untreated lands that would have been left by the year 2000, given the present ongoing programs, would be added to the current programs and treated by 2000. Nearly 447,000 acres in the Upper Yellowstone Planning Area would be treated under the accelerated program.

Table VI-2. Display of Beneficial and Adverse Effects
NED Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
MULTIPURPOSE (IRRIGATION) PROJECTS				
Flathead Creek Project SCS Gavin's Point Study Gallatin/Park Counties	First Cost $3,088,700 Annual Benefits 231,900 Annual Costs 216,400 Net Benefits 15,500	Beneficial Effects: Increased late season in-stream flows, 500 acres increased waterfowl habitat/fishery. Adverse Effects: Loss of 2 miles small mountain stream, 500 acres riparian/dryland habitat.	User Benefits $231,900 Regional Benefits 101,200 Net Benefits 116,700	Beneficial Effects: Stabilize population/income, increase seasonal jobs. Adverse Effects: Minor population impacts during construction, minimized with trailer housing.
Sweet Grass Creek Project SCS Gavin's Point Study Park/Sweet Grass Counties	First Cost $4,104,000 Annual Benefits 748,000 Annual Costs 334,500 Net Benefits 413,500	Beneficial Effects: 800 acres improved waterfowl habitat, improved upland wildlife habitat; increased late summer flows. Adverse Effects: Loss of 2 miles of live stream, 170 acres of prairie habitat; increased dissolved solids in return flows.	User Benefits $748,000 Regional Benefits 238,400 Net Benefits 651,900	Beneficial Effects: Minor population stabilization, more seasonal work, economic stability, construction employment. Adverse Effects: Minor population impact on town of Big Timber during 2 construction seasons could be handled by motels and trailer parks.
East Rosebud Creek Project SCS Gavin's Point Study Carbon/Stillwater Counties	First Cost $1,986,200 Annual Benefits 182,100 Annual Costs 137,800 Net Benefits 44,300	Beneficial Effects: Increased flat water, waterfowl habitat, streamflow, ice fishing. Adverse Effects: Loss of 2 miles of stream habitat, 800 acres mountain valley, 2 miles stream fishery.	User Benefits $182,100 Regional Benefits 37,800 Net Benefits 82,100	Beneficial Effects: Minor population stabilization, economic improvement, more seasonal jobs, construction employment. Adverse Effects: Motels/trailer courts in Red Lodge/Columbus can handle construction workers/families.
Pryor Creek Project SCS Wind/Bighorn Survey Bighorn/Yellowstone Counties	First Cost $3,496,900 Annual Benefits 322,100 Annual Costs 243,600 Net Benefits 78,500	Beneficial Effects: Create a 750 acre lake, trap sediment, improve wildfowl habitat, reduce bank erosion, increase low flows, improve pheasant habitat, reduce wind erosion. Adverse Effects: Mud flat during drawdown, inundate 2 miles Class IV stream/700 acres of bottom land, slight increase in dissolved solids.	User Benefits $322,100 Regional Benefits 155,900 Net Benefits 126,500	Beneficial Effects: Stabilize population, preserve family farms, improve Indian income and employment, reduce flooding, provide flatwater recreation. Adverse Effects: Relocate one farmstead; influx of 16 to 20 construction workers, some with families would cause few problems

Table VI-2 (Cont.). Display of Beneficial and Adverse Effects
NED Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT: NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
SINGLE PURPOSE (IRRIGATION)				
Whitehorse Bench Unit USBR-Pick-Sloan Missouri Basin Program, Carbon County, Montana	First Cost $2,162,000 Annual Benefits 213,400 Annual Costs 181,100 Net Benefits 32,300	Beneficial Effects: Improved pheasant, waterfowl, fur bearer habitat. Reduced wind erosion. Adverse Effects: Visual intrusion of pumping plant, transmission lines, and other features. Minor reduction in quantity/quality of river water, exhaust emissions from farm equipment	User Benefits $213,400 Regional Benefits 418,900 Net Benefits 451,200	Beneficial Effects: Reduce outmigration, increase/stabilize farmers/merchants income. Adverse Effects: Billings could absorb construction crews/families without effecting growth rate.
Huntley South Unit USBR--Single Purpose Irrigation Study, Yellowstone County	First Cost $5,142,000 Annual Benefits 409,700 Annual Costs 390,000 Net Benefits 19,700	Beneficial Effects: Improved pheasant, waterfowl, fur bearer habitat. Reduced wind erosion. Adverse Effects: Visual intrusion of facilities, reduction in grouse habitat, minor reduction in quantity/quality of river water, exhaust emissions from farm equipment.	User Benefits $409,700 Regional Benefits 839,900 Net Benefits 859,600	Beneficial Effects: Reduce outmigration, increase/stabilize farmers'/merchants' income. Adverse Effects: Influx of 95 workers/families for 2 years would strain community facilities, including 32 additional students in schools.
FLOOD CONTROL PROJECT				
West Billings Diversion COE--Level B Study Yellowstone County	First Cost $3,620,000 Annual Benefits 334,000 Annual Costs 247,000 Net Benefits 87,000	Improve human environment through weed reduction.	User Benefits $334,000 Regional Benefits 896,000 Net Benefits 983,000	Protect 2,080 acres of urban land and improvements from flooding; enhance the health and social well-being of 60,000 residents; encourage more orderly development in the protected areas.

Table VI-2 (Cont.). Display of Beneficial and Adverse Effects, NED Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
<u>LAND CONSERVATION</u> Accelerated Land Conservation				
A. State and Private Lands 431,000 Acres B. National Resource Lands 13,500 Acres C. Forest Service Lands 2,400 Acres	A. Cap. Cost $18,304,000 *Ann. Equiv. Cost $1,483,400 B. Cap. Cost $167,000 *Ann. Equiv. Cost $13,500 C. Cap. Cost $991,000 *Ann. Equiv. Cost $80,300 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6 3/8 percent interest for 25 years.	<u>Beneficial Effects</u>: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condition. Increased vegetative cover resulting from improved management of existing resources. Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries. Reduce soil nutrients from entering streams and the underground water table. Reduction of undesirable return flow to streams. <u>Adverse Effects</u>: Additional depletion of streams due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.	Maintain and/or enhance the output of goods and services to users in the region. Provide additional employment in the application and maintenance of proposed measures.	Ensures that the resource is available for use in the future.

PLATE VI-1 NED PROJECTS

1. Flathead Creek
2. Sweet Grass Creek
3. East Rosebud Creek
4. White Horse Bench Unit
5. West Billings Diversion
6. Pryor Creek (SCS)
7. Huntley South Unit
8. Accelerated Land Conservation Program

THE

ENVIRONMENTAL QUALITY

PLAN

The objective of the Environmental Quality (EQ) Plan is the management, conservation, preservation, restoration, or improvement of the areas natural (or cultural) resources and ecological systems. Although the EQ Plan is not subjected to a benefit/cost analysis, the plan should reflect the most efficient and effective way of obtaining desired results.

Environmental quality is considered fully as important as economic development in the Level B planning process. However, EQ elements are frequently submitted with insufficient economic and/or physical data to be thoroughly evaluated. It is difficult to put a dollar value on environmental change, positive or negative; and often there is a lack of baseline data to properly evaluate the environmental effects of a man-caused change.[1/]

Fish and Wildlife

Spawning Barriers

This project would remove spawning barriers on Cedar, Eightmile, and Rock Creeks. Highway culverts on Cedar and Eightmile Creeks and a large railroad culvert on Rock Creek are barriers which prohibit upstream passage of spawning salmonids from the Yellowstone River.

Flow Regimen Improvement of Tributaries

The tributaries of the Yellowstone above Livingston provide a significant potential spawning area for salmonids that normally reside in the mainstem of the Yellowstone. Improved irrigation management, land use practices, and perhaps water right purchases could improve stream flows.

1/ The Montana Department of Fish and Game has furnished much of the EQ narrative in this and the other Montana Level B reports.

Antelope Creek Storage

This storage site is located on Antelope Creek but would be filled from the Shields River via a three mile-long feeder canal. About 19,000 acre-feet of spring runoff would be available for storage and used for fall and winter flow augumentation. Although Bureau of Reclamation studies have shown that this site would not be economically feasible as an irrigation project, the benefits to fish, wildlife, and recreation could outweigh economic costs.

Yellowstone River Islands

The project would entail the securing of easements to protect wildlife habitat of Yellowstone River Islands while maintaining private ownership and compatible private land use.

Broadview-Wheat Basin--Wildlife Refuges

The project would provide a firm water supply to the existing wildlife refuges near Molt. It would also allow development of new refuge or waterfowl hunting area in the Broadview-Acton Basin. This scheme could be tied to the Calamity Jane proposal--a Billings water supply alternative. The Bureau of Reclamation is working on two water supply alternatives but neither has been accepted by the City of Billings.

Beartooth Wilderness Area

The creation of the Beartooth Wilderness Area would combine the Absaroka and Beartooth Primitive Areas into a unit ensuring the preservation and protection of a unique natural area.

Sweet Grass Creek Storage

Flow augumentation in the fall and winter months is the main objective of this proposal. This project is identical to the NED project of the same name but with a different purpose.

Instream Flow

The instream flow levels requested by the Montana Department of Fish and Game have been adopted in the EQ plan except where they are exceeded by the reservation requests of the Department of Health and Environmental Sciences in which case the higher value is recommended as the EQ value. Table VI-3 illustrates the relations between the two requests for the only reach in this planning area, where the DHES requests exceed those of Fish and Game.

Table VI-3. Recommended EQ Flows for the Yellowstone River From the Mouth of the Clarks Fork Yellowstone to the Mouth of the Bighorn River -Acre-Feet-

	DHES Reservation Request	Fish and Game Reservation Request	Recommended EQ Flows
January	240,000	153,720	240,000
February	217,000	138,845	217,000
March	210,000	178,315	210,000
Arpil	197,000	214,215	214,215
May	321,000	514,455	514,455
June	694,000	1,215,070	1,215,070
July	204,000	577,784	577,784
August	160,000	295,140	295,140
September	227,000	220,165	227,000
October	273,000	221,355	273,000
November	230,000	208,264	230,000
December	211,000	172,165	211,000
Totals	3,184,000	4,109,493	4,424,664

Source: Draft Environmental Impact Statement for Water Reservation Applications, Montana Department of Natural Resources and Conservation, December 1976.

These instream flow levels would virtually eliminate any new full-service irrigation from the Yellowstone mainstem, unless storage is provided to serve either the instream flow or irrigation needs, or both. Since storable flows would be available in only a few months of most years, storage yields would be low and very expensive.

Although the requested flows vary from Gardiner to the Bighorn River, the effect of the flows would be the same. At Livingston, the request is

for all streamflow (subject to existing rights) after August 11, which precludes new irrigation from natural flows, after that time even though about 25 percent of the crop water needs occur after that time. Farther downstream, the flow level is for the 70th-percentile low flow; at this level, water would only be available for development seven years out of ten, on the average. For efficient, fullservice irrigation systems, a good water supply is usually considered to be necessary about eight years out of ten, as a minimum. Many irrigators in Montana, however, continue to operate with a less reliable water supply.

For several streams, no quantified flow of water was specified, in the Fish and Game request. Most of these are Yellowstone mainstem tributaries for which the requested levels are the instantaneous flow from August 11 to May 9 and a 24-hour dominant discharge sometime between May 11 and August 10:[1/]

Bear Creek	Eightmile Creek
Mol Heron Creek	Mill Creek
Cinnabar Creek	Trail Creek
Cedar Creek	Suce Creek
Tom Moner Creek	Coke Creek
Rock Creek	Billman Creek
Big Creek	Fleshman Creek
Sixmile Creek	Mission Creek
Fridley Creek	Little Mission Creek

Irrigation of alfalfa and hay has been and will probably continue to be the major water use along these streams. If implemented, this request would make water unavailable for additional irrigation from August 11 through the end of the growing season, during which time the crop water requirement is about 25 percent of the annual total.

Most of the streams in this area appear to be fully developed for irrigation. That is, without additional water storage, few of these streams

1/ See table IV-14.

could support much new irrigation. New storage could probably carry spring flood water over to satisfy both irrigation demands and the instream flow requests, but would probably be too expensive for irrigators.

For four Shields River tributaries, Smith, Flathead, Cottonwood, and Rock Creeks, the application requests the instantaneous flow from July 21 to March 31, and a specified 24-hour dominant discharge for each stream sometime between April 1 and July 20. These proposals are similar to those made for the Yellowstone tributaries, except that the application requests instantaneous flows beginning three weeks earlier. These levels would make even less water available to irrigators. Without storage, however, little new irrigation would be developed, with or without the instream reservation. It is doubtful that irrigators could afford to build dams, especially ones which could pass a 24-hour dominant discharge.

The requested flows would maintain fish habitat, aquatic insect, and lower plant and animal life which sustain fish. The Yellowstone River and its tributaries are important fishing and recreation areas used by the people of Montana and the Nation. The recreational use of these waters is an important outlet from day-to-day pressures and is important in the human experience in this area and is recognized as worthy of protection by our water use statutes. The fish species which would be protected by this flow request contribute to the well being of the people of Montana and those visitors who come to enjoy the splendor Montana has to offer.

These instream flows are for that amount of water considered necessary to sustain the organisms without significant long-term reduction in quantity and quality thereof. Increased water withdrawals over existing levels will, in the long run, reduce availability of habitat and consequently reduce the

number of organisms which can healthily occupy that habitat.

Aquatic organisms depend on lower forms of plants or other animals for their existence. These lower forms also have specific water requirements (volume) needed to grow and reproduce. Reduction in availability of lower aquatic forms ultimately reduce the number, health, and well being of those organisms at higher trophic levels. Reduced streamflows also affect the quality of water which is necessary to sustain these organisms. Consequences of reduced streamflow are higher water temperatures and increased amounts of dissolved solids.

Thus, there are several ways reduced streamflow can adversely affect aquatic organisms: (1) reduction in the physical size or character of living space, (2) alteration of the food chain and/or reduction of the availability of food organisms, and (3) change in water quality which alters living conditions for plant and animal life. In short, streamflows should be protected from depletion to prevent loss of habitat conditions which allow aquatic organisms to survive.

Land Conservation

Accelerated Land Conservation Program

Under the accelerated land conservation program, 50 percent of the untreated land that would have been left by the year 2000, given the present ongoing programs, would be added to the current programs and treated by 2000. Nearly 447,000 acres in the Upper Yellowstone Planning Area would be treated under the accelerated program.

Streambank Greenbelt Program

This program could be developed with the aid of the SCS, local soil conservation districts, and the 208 programs. The program would provide:

(1) protection from stream bank erosion; and (2) improved fish and wildlife habitat. Studies need to be made to identify existing denuded areas that should be restored, and forested and grassed areas that should be protected from development.

Rehabilitation of Shields River Headwater Basin

Streams in the Shields River basin support a significant cold-water fishery. High quality, cold-water streams are characterized by clean, well oxygenated water, stable banks and channel configuration abundant food producing areas, adequate cover and spawning areas for resident salmonoid fish populations.

The major threat to the cold-water aquatic resource in the study area is improper land and water use management. Logging and associated road-building activities and detrimental agricultural practice (especially dewatering of streams for irrigation purposes and mechanical alteration of stream channels and banks) are the primary human-related activities which are affecting the aquatic resources in the Shields River drainage.

Extensive clearcutting of forested areas has occurred on both private and U.S. Forest Service lands in the headwater basin of the Shields River. The Forest Service currently plans little additional timber harvest in the Shields headwater basin, since most Federal land in that area has already undergone heavy logging. However, extensive timber harvest on private lands in the basin is likely. If private lands are indiscriminately logged, it is probable that additional environmental degradation will occur in the upper watershed and lead to altered peak flow patterns and increased sediment yield that may affect the entire river.

Deforestation problems in the study area are not confined to the Shields drainage. Several tributary drainages to the Upper Yellowstone River have sustained considerable clear and selective cutting of their forest cover.

These include the Mill, Bear, Train, Tom Miner and Rock creek drainages.

Rehabilitation would enhance the existing environment and probably could restore the integrity of the areas streams.

Wild, Scenic, and Recreational Rivers

Yellowstone River

The 225 mile reach of the Yellowstone River from Gardiner, Montana, to Pompeys Pillar is identified on the rivers selected for 5(d) status under the Wild and Scenic Rivers Act, P.L. 90-542. This reach of the Yellowstone River is also included in proposed legislation to amend the Wild and Scenic Rivers Act by designating certain rivers for study as potential additions to the National Wild and Scenic Rivers System.

Studies carried out in conjunction with the Bureau of Reclamation, Billings Water Supply Project, provided preliminary information that, with the exception of a 37-mile reach between Sportsman's Park just above Laurel to Spraklin Island near Huntley, the river possesses values making it eligible for addition to the National Wild and Scenic Rivers System. The study also indicated that the 37 mile reach between Sportsman's Park and Spraklin Island has potential for providing water based recreation opportunities and could be made a part of the National System with proper rehabilitation and development.

Adjacent to the river, between Gardiner and Livingston, is the recently abandoned Burlington Northern Railroad right-of-way. Acquisition of lands includes this railroad right-of-way which lends itself to trail development and would provide additional access to the river.

Boulder, Shields, and Stillwater Rivers

Preliminary information indicates that these segments of rivers possess values that would make them eligible for State protection.

The rivers and their environments offer visitors recreation opportunities for fishing, hunting, camping, picnicking, sightseeing, canoeing, and other water-related activities.

Boulder River - Upside-Down Creek to confluence with the Yellowstone River - 58 miles

Shields River - Flathead Creek to confluence with the Yellowstone River - 40 miles

Stillwater River - 20 miles above U.S. Forest Service Woodbine Campground to confluence with Yellowstone River - 65 miles

These plans include acquisition of land in fee title, for both major and minor access areas, and acquisition of lands or easements for the protection of the rivers and their environments.

Table VI-4. Display of Beneficial and Adverse Effects,
EQ Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FISH AND WILDLIFE Removal of Fish Spawning Barriers to Tributary Streams Park County	Modification of culverts could cost about $2,000 each; however, if bridges became necessary the costs would escalate tremendously.	Beneficial Effects: Removal of barriers would allow passage of salmonids from the Yellowstone River to upstream spawning site in the smaller tributaries. Adverse Effects: Increased turbidity during installation.	Not available.	Not available.
Flow Regimen Improvement of Tributary Streams above Livingston	Not available.	Provision of more adequate instream flows would improve trout habitat in these tributaries.	Not available.	Costs to landowners may be incurred in instituting better water conservation and land use measures.
Antelope Creek Storage Park County	First Cost 9,606,000 Annual Benefits Unknown Annual Costs 621,700 Net Benefits Unknown	Beneficial Effects: Provision of adequate instream flows for fish and wildlife during summer and fall in Shields River. Adverse Effects: Visual effects of dam and canal. Loss of Flora and Fauna in reservoir area.	Not available.	Beneficial Effects: Benefits would accrue to locality from employment and other short term secondary benefits. The reservoir would also provide some recreational benefits to individuals. Adverse Effects: Loss of agricultural income in reservoir area. Impact of construction workers and families.
Management of Yellowstone River Islands to Improve Goose and Wildlife Habitat	Not available.	Proper management would increase the goose pupulation in the basin. Other types of wildlife utilizing the island would benefit also.		Benefits would accrue from additional recreational benefits stemming from increased hunting opportunities.
Wheat Basin and Broadview Wildlife Refuges Stillwater and Yellowstone Counties	Not available.	Provision of a constant water supply for existing wildlife refuges while allowing for development of new refuges.	Not available.	Not available.

Table VI-4. (Cont.) Display of Beneficial and Adverse Effects, EQ Plan, Upper Yellowstone, Montana

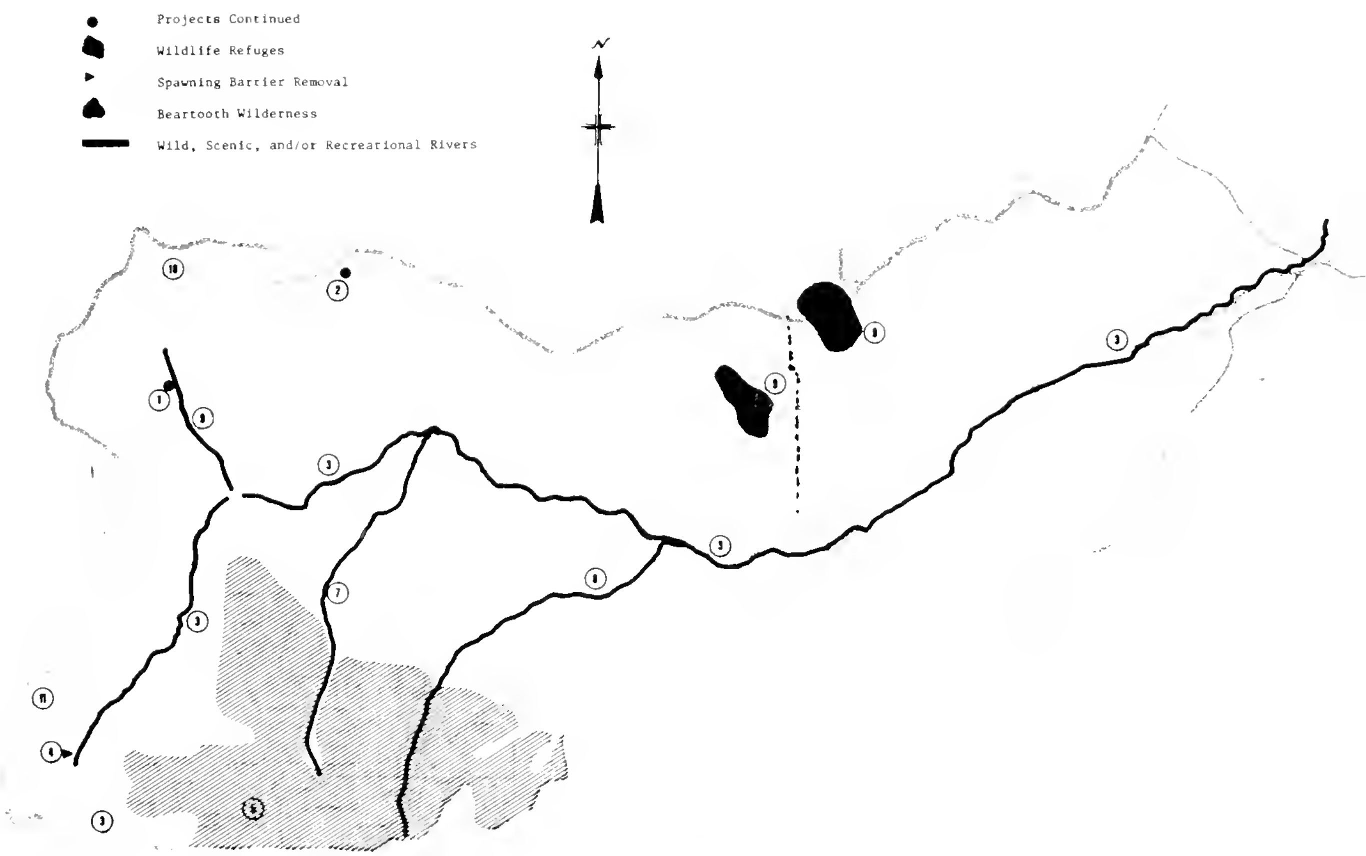
PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FISH AND WILDLIFE (CONT.)				
Classify the Beartooth and Absaroka Primitive Areas as a Wilderness Area	Nct available.	Maintain a unique natural area in its natural state.	Not available.	Not available.
Sweet Grass Creek Storage Sweet Grass County	First Cost $4,104,000 Annual Benefits Unknown Annual Costs 334,500 Net Benefits Unknown	Beneficial Effects: Provision of adequate in-stream flows for fall and winter for fish and wild-life. Adverse Effects: Visual intrusion of dam. Loss of Flora and Fauna in reservoir area.	User Benefits Unknown Regional Benefits $101,200 Net Benefits Unknown	Beneficial Effects: Minor population stabiliza-tion, more seasonal work, economic stability, con-struction employment. Adverse Effects: Minor population impact on town of Big Timber during 2 construction seasons could be handled by motels and trailer parks.
Instream Flows Compare the reservation requests of the Departments of Fish and Game and Health and Environmental Sciences. Take the highest flow in each case.	Beneficial Effects: Precludes increased munici-pal water treatment costs and costs to irrigator due to loss of quality. Adverse Effects: No new full service irrigation.	Preservation of existing fish and wildlife habitat and water quality. Limits further degradation.	Same as NED.	Beneficial Effects: Increased income for recreation oriented business. Adverse Effects: Potential negative effects on agricultural employment and expansion. Possibly limits industrial and domes-tic future uses of river water--again limiting income and employment
LAND CONSERVATION Accelerated Land Conservation A. State and Private Lands 431,000 Acres B. National Resource Lands 13,500 Acres C. Forest Service Lands 2,400 Acres	A. Cap. Cost $18,304,000 *Ann. Equiv. Cost $1,483,400 B. Cap. Cost $167,000 *Ann. Equiv. Cost $13,500 C. Cap. Cost $991,000 *Ann. Equiv. Cost $80,300 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6 3/8 percent interest for 25 years.	Beneficial Effects: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condi-tion. Increased vegetative cover resulting from improved management of existing resources.	Maintain and/or enhance the output of goods and services to users in the region. Provide additional employ-ment in the application and maintenance of proposed measures. Provide additional permanent employment in processing increased goods and services.	Ensures that the resource is available for use in the future.

Table VI-4. (Cont.) Display of Beneficial and Adverse Effects, EQ Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
LAND CONSERVATION (CONT.) Accelerated Land Conservation (Cont.)		Beneficial Effects (Cont.): Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries. Reduce soil nutrients from re-entering streams and the underground water table. Reduction of undesirable return flows to streams. Adverse Effects: Additional depletion of streams due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.		
Streambank Greenbelt Program	Not available.	Program would add to fish and wildlife habitat while helping to prevent streambank erosion.	Not available.	Not available.
Rehabilitation of the Headwater Basin of the Shields River. Park County	Not available.	Rehabilitation of the area would alleviate the severe sedimentation problems that now exist in the area. Water quality and freshwater salmonid habitat would be improved.	Not available.	Not available.

Table VI-4. (Cont.) Display of Beneficial and Adverse Effects, EQ Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT: NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
WILD, SCENIC, AND RECREATIONAL RIVERS				
Yellowstone River Establish National Wild and Scenic River designation for the Yellowstone River - Gardiner to Pompeys Pillar - 225 miles.	First Cost $38,547,000 Annual Benefits1/ 2,832,500 Annual Costs 3,323,700 Net Benefits (491,200)2/	The natural beauty along these reaches of streams will be preserved for present and future generations. Flora and fauna habitat values will be protected. A higher level of recreation use will be offset by better protection of the resource.	Tourism is a major contributor to the area and State economies. Recreation benefits resulting from preservation of these river reaches is in the state/regional interest.	The pleasures associated with river-oriented recreation are important to social well-being. Local residents as well as tourists relax and revitalize themselves through their association with the pleasures provided by attractive streams.
Boulder River Establish State recreation river designation for the Boulder River - Upside-Down Creek to confluence with the Yellowstone River - 58 miles (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $4,130,000 Annual Benefits 283,500 Annual Costs 385,800 Net Benefits (102,300)	Same as above.	Same as above.	Same as above.
Shields River Establish State recreation river designation for the Shields River - Flathead Creek to confluence with the Yellowstone River - 40 miles. (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $6,568,000 Annual Benefits 195,500 Annual Costs 507,000 Net Benefits (311,500)	Same as above.	Same as above.	Same as above.
Stillwater River Establish State recreation river designation for the Stillwater River - 20 miles above U.S. Forest Service Woodbine Campground to confluence with the Yellowstone River - 65 miles. (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $4,964,000 Annual Benefits1/ 317,700 Annual Costs 454,500 Net Benefits (136,800) 1/ Hunting and fishing benefits that have not been provided and are not included. 2/ The parentheses indicate a negative number.	Same as above	Same as above.	Same as above.



YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

PLATE VI-2 EQ PROJECTS

1. Antelope Creek
2. Sweet Grass Creek
3. Yellowstone River Wild/Scenic
4. Spawning Barrier Removal
5. Beartooth Wilderness Area
6. Shields River Scenic/Recreational
7. Boulder River Scenic/Recreational
8. Stillwater River Scenic/Recreational
9. Broadview-Wheat Basin Wildlife Refuge
10. Rehabilitation of Shields Headwater Basin
11. Flow Regimen Improvement
12. Yellowstone River Islands
13. Accelerated Land Conservation Program
14. Streambank Greenbelt Program
15. Minimum Instream Flows

THE

STATE-REGIONAL DEVELOPMENT

ELEMENTS

Local development is accomplished by utilizing available local, regional, and national resources to alleviate chronic or cyclical economc conditions of low income, unemployment, or other persistent economic or social problems within the region, but only in those cases where there is a known or reasonable predictable source of financing for the costs associated with non-national benefits. An acceptable plan with SRD emphasis would provide:

1. Monetary benefits (user benefits plus other regional benefits) must exceed national economic costs;
2. Sufficient repayment capability is available to meet cost-sharing requirements; and
3. A demonstration that non-Federal financing can be expected.

Single Purpose Irrigation

Seven Mile - Sitting Bull Unit

The name of this 6500 acre unit applies to two areas which at one time were investigated as separate units--Seven Mile Flat and Sitting Bull. Under the present plan these areas would be combined into one unit, and its irrigation water would be furnished by a single river pumping plant.

The pumping plant with a capacity of 150 cubic feet per second (cfs), would lift Yellowstone River water 154 feet to Seven Mile Canal. The Seven Mile Canal would total 33 miles in length. The first 17.4 miles would serve the Seven Mile area, beginning with a capacity of 130 cfs.

About 2 miles from the end of Seven Mile Canal the Sitting Bull Relift Pumping Plant would lift 23 cfs into a higher canal extension 17.2 feet above the plant intake. This plant also would serve a small lateral 58.5 feet above the main canal by pumping 8.6 cfs with a single pump and a separate discharge line.

Power for these plants would be furnished by transmission lines built from the Yellowstone Valley Electric Co-op's substation at Custer, Montana.

Approximately 1,700 acres in the proposed unit are now irrigated. The rest is dry-farmed and grazed. If the irrigation system is not built, present land use probably will continue. Principal crops under irrigation probably would be corn for silage, barley, alfalfa hay, and rotation pasture.

Table VI-5. Display of Beneficial and Adverse Effects
SRD Elements, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
SINGLE PURPOSE IRRIGATION				
Seven Mile-Sitting Bull Unit USBR--Report on Yellowstone Division Yellowstone County	First Cost 10,449,000 Annual Benefits 590,000 Annual Costs 719,000 Net Benefits (129,000)1/ 1/ Parentheses denote a negative number.	Beneficial Effects: Improved upland game bird hunting. Improved habitat for muskrats and mink in drains. Adverse Effects: Return flows will increase TDS in receiving stream.	User Benefits 590,000 Regional Benefits 744,000 Net Benefits 615,000	Beneficial Effects: Dryland Farmers who would receive irrigation water would develop more stable operations due to increased reliability of water source. Fluctuations in annual income would lessen. Adverse Effects: Small impact on services from construction workers and families.

PLATE VI-3 SRD PROJECT

Legend

- ● Seven Mile - Sitting Bull Unit

YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

CHAPTER VII

THE RECOMMENDED PLAN

Selection of Plan Elements

The plan described in this chapter is a selection of alternatives, taken from the NED, EQ, and SRD plans, that are acceptable for implementation if the needed water supply could be made available. It is a known fact, however, that the water needs of all of the selected elements cannot be met. The instream flow levels taken from the EQ plan, for example, would preclude the provision of a full water supply for all of the irrigation described in the future without plan and the NED plan. There are other mutually exclusive elements in the group selected for consideration in the so-called recommended plan.

No tradeoff analysis was performed to select the optimum combination of instream flows and water-diversion projects. The analysis was not performed for two principal reasons: (1) there was limited time to do tradeoff analyses after the NED, EQ, and SRD plans were completed, and more importantly (2) the State agencies with primary interests in such an analysis were unable to participate on a comprehensive basis. The Departments of Natural Resources and Conservation, Fish and Game, and Health and Environmental Sciences each had requests for reservations of water pending with the Board of Natural Resources. These agencies were committed to defending their full request and were not able to accept a recommended plan for the Level B Study that would compromise their request for a reservation. Under these conditions, no consensus on instream flows was possible. The instream flow levels described in this plan are levels designed to meet a fish and wildlife and water quality objective, rather than a recommended level formulated by tradeoff analysis.

Hydrology Supplement

The number of elements that have been selected for the recommended plan is therefore greater than it would have been if the reservation decision already had been made by the Board of Natural Resources. Until that decision is made, it is difficult to assess the water quantity and quality impacts that would stem from any set or subsets of proposed projects (e.g., the SCS storage projects and/or the USBR pumping projects).

The hydrology studies will be released in the form of a supplement to these area report tests, and will evaluate the recommended plans of each planning area.[1/] In Montana, the following set and subsets of projects (alternatives) have been examined:

1. The F/WO situation.
2. All recommended projects.
3. Recommended projects minus SRD projects.
4. Recommended projects minus pumping and SRD projects.
5. Recommended projects minus storage and SRD projects.
6. Recommended projects minus the Hardin Unit and SRD projects.

In addition, a water quality analysis (total dissolved solids) is tied to each of the alternatives. Each alternative can be compared to the reservation decision results when they are available.

The hydrology studies also assume a certain amount of private development which is represented by the F/WO situation described in Chapter V; therefore, all consumptive uses of water should be accounted for by the studies. The Hydrology Supplement is critical to proper assessments of the impacts stemming from the elements that follow in the Recommended Plan. It is hoped that the Plan, in conjunction with the Hydrology Supplement, can serve the people of the area in the sense that they may view the consequences of alternative courses of action.

1/ The U.S. Bureau of Reclamation conducted the hydrology studies from its Field Planning Office in Billings, Montana.

- Projects Continued
- Wildlife Refuges
- Spawning Barrier Removal
- Beartooth Wilderness
- Wild, Scenic, and/or Recreational Rivers

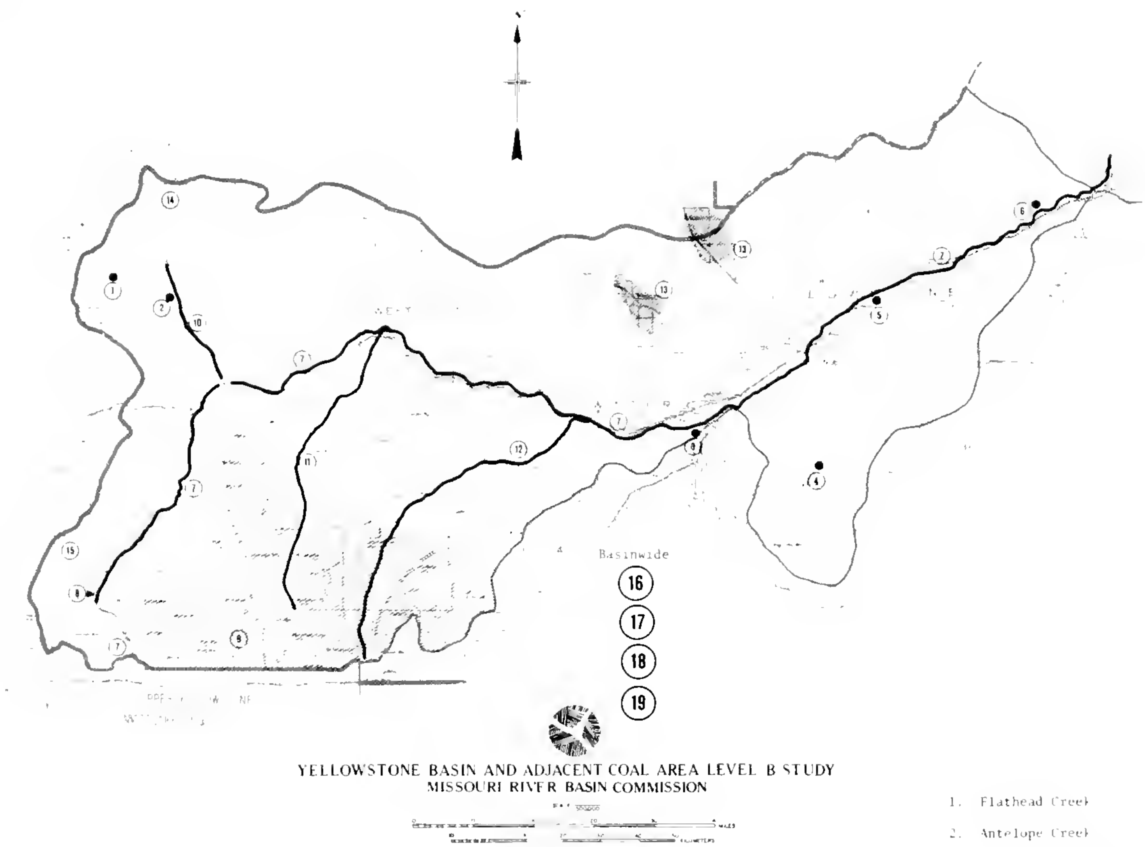


PLATE VII-1 ELEMENTS OF THE RECOMMENDED PLAN

1. Flathead Creek
2. Antelope Creek
3. White Horse Bench Unit
4. Pryor Creek (SCS)
5. Huntley South Unit
6. Seven Mile - Sitting Bull Unit
7. Yellowstone River Wild/Scenic
8. Spawning Barrier Removal
9. Beartooth Wilderness Area
10. Shields River Scenic/Recreational
11. Boulder River Scenic/Recreational
12. Stillwater River Scenic/Recreational
13. Broadview-Wheat Basin Wildlife Refuge
14. Rehabilitation of Shields Headwater Basin
15. Flow Regimen Improvement
16. Accelerated Land Conservation
17. Management of Yellowstone River Islands
18. Streambelt Greenbelt Program
19. Instream Flow Maintenance

Display of the Plan

The elements selected for the Recommended Plan and their suggested implementation dates (subject to Level C studies) are shown in Plate VII-1. A summary of beneficial and adverse affects (four-account analysis) of each element is found at the end of this chapter in Table VII-1. In addition to these Plan elements, the recommendations listed in Chapter X are also part of the Recommended Plan.

In the Upper Yellowstone Planning Area only two projects were rejected by the State Study Team; the reasons for this are given hereinafter. It must be noted also that F/WO development coupled with NED and SRD irrigation projects are bound to affect the instream flow levels sought in this same plan. It is for just this reason that the elements found in this chapter should not be considered to be immutable--they must be considered in light of the Hydrology Supplement. Narratives regarding the elements found in the Recommended Plan have already been presented in Chapter VI.

Projects Rejected

The State Study Team rejected two storage projects that appeared in the NED plan of Chapter VI. One of these projects--Sweet Grass Creek--also appeared, albeit for a different purpose, in the EQ plan. It was rejected on the grounds that the site would be very difficult to obtain and that there appeared to be little public support for the project, for either purpose. The second project was East Rosebud Creek which was rejected on environmental (loss of excellent bottom-land, deer habitat and stream fishery) and esthetic grounds.

The West Billings Diversion (flood control) has not been included in the plan because of a perceived lack of public interest; instead the study team has recommended (in Chapter X) that it be replaced by flood plain zoning and flood insurance programs.

Table VII-1. Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
MULTIPURPOSE (IRRIGATION) PROJECTS				
Flathead Creek Project SCS Gavin's Point Study Gallatin/Park Counties	First Cost $3,088,700 Annual Benefits 231,900 Annual Costs 216,400 Net Benefits 15,500	Beneficial Effects: Increased late season in-stream flows, 500 acres increased waterfowl habitat/fishery. Adverse Effects: Loss of 2 miles small mountain stream, 500 acres riparian/dryland habitat.	User Benefits $231,900 Regional Benefits 101,200 Net Benefits 116,700	Beneficial Effects: Stabilize population/income, increase seasonal jobs. Adverse Effects: Minor population impacts during construction, minimized with trailer housing.
Pryor Creek Project SCS Wind/Bighorn Survey Bighorn/Yellowstone Counties	First Cost $3,496,900 Annual Benefits 322,100 Annual Costs 243,600 Net Benefits 78,500	Beneficial Effects: Create a 750 acre lake, trap sediment, improve wildfowl habitat, reduce bank erosion, increase waterflows, improve pheasant habitat, reduce wind erosion. Adverse Effects: Mud flat during drawdown, inundate 2 miles Class IV stream/700 acres of bottom land, slight increase in dissolved solids.	User Benefits $322,100 Regional Benefits 155,900 Net Benefits 126,500	Beneficial Effects: Stablize population, preserve family farms, improve Indian income and employment, reduce flooding, provide flatwater recreation. Adverse Effects: Relocate one farmstead; influx of 16 to 20 construction workers, some with families would cause few problems.
SINGLE PURPOSE (IRRIGATION)				
Whitehorse Bench Unit USBR-Pick-Sloan Missouri Basin Program, Carbon County, Montana	First Cost $2,162,000 Annual Benefits 213,400 Annual Costs 181,100 Net Benefits 32,300	Beneficial Effects: Improved pheasant, waterfowl fur bearer habitat. Reduced wind erosion. Adverse Effects: Visual intrusion of pumping plant, transmission lines, and other features. Minor reduction in quantity/quality of river water, exhaust emissions from farm equipment.	User Benefits $213,400 Regional Benefits 418,900 Net Benefits 451,200	Beneficial Effects: Reduce outmigration, increase/stabilize farmers/merchants income. Adverse Effects: Billings could absorb construction crews/families without effecting growth rate.

Table VII-1 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
SINGLE PURPOSE (IRRIGATION) Cont				
Huntley South Unit USBR--Single Purpose Irrigation Study, Yellowstone County	First Cost $5,142,000 Annual Benefits 409,700 Annual Costs 390,000 Net Benefits 19,700	Beneficial Effects: Improved pheasant, waterfowl, fur bearer habitat. Reduced wind erosion. Adverse Effects: Visual intrusion of facilities, reduction in grouse habitat, minor reduction in quantity/quality of river water, exhaust emissions from farm equipment.	User Benefits $409,700 Regional Benefits 839,900 Net Benefits 859,600	Beneficial Effects: Reduce outmigration, increase/stabilize farmers/merchants income. Adverse Effects: Influx of 95 workers/families for 2 years would strain community facilities, including 32 additional students in schools.
Seven Mile-Sitting Bull Unit USBR--Report on Yellowstone Division Yellowstone, County	First Cost $10,449,000 Annual Benefits 590,000 Annual Costs 719,000 Net Benefits (129,000) 1/ 1/ Parentheses denote a negative number.	Beneficial Effects: Improved upland game bird hunting. Improved habitat for muskrats and mink in drains. Adverse Effects: Return flows will increase TDS in receiving stream.	User Benefits $590,000 Regional Benefits 744,000 Net Benefits 615,000	Beneficial Effects: Dryland Farmers who would receive irrigation water would develop more stable operations due to increased reliability of water source. Fluctuations in annual income would lessen. Adverse Effects: Small impact on services from construction workers and families.
LAND CONSERVATION Accelerated Land Conservation A. State and Private Lands 431,000 Acres B. National Resource Lands 13,500 Acres C. Forest Service Lands 2,400 Acres	A. Cap. Cost $18,304,000 *Ann. Equiv. Cost $1,483,400 B. Cap. Cost $167,000 *Ann. Equiv. Cost $13,500 C. Cap. Cost $991,000 *Ann. Equiv. Cost $80,300 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6-3/8 percent interest for 25 years.	Beneficial Effects: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condition.	Maintain and/or enhance output of goods and services to users in the region. Provide additional employment in the application and maintenance of proposed measures.	Ensures that the resource is available for use in the future.

Table VII-1 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
LAND CONSERVATION (Cont.) Accelerated Land Conservation		Beneficial Effects: Increased vegetative cover resulting from improved management of existing resources. Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries. Reduce soil nutrients from entering streams and the underground water table. Reduction of undesirable return flow to streams. Adverse Effects: Additional depletion of streams due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.		
Streambank Greenbelt Program	Not Available.	Program would add to fish and wildlife habitat while helping to prevent streambank erosion.	Not Available.	Not Available.
Rehabilitation of the Headwater Basin of the Shields River. Park County	Not Available.	Rehabilitation of the area would alleviate the severe sedimentation problems that now exist in the area. Water quality and freshwater salmonid habitat would be improved.	Not Available.	Not Available.

Table VII-1 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FISH AND WILDLIFE Removal of Fish Spawning Barriers to Tributary Streams Park County	Modification of culverts could cost about $2,000 each; however, if bridges became necessary the costs would escalate tremendously.	Beneficial Effects: Removal of barriers would allow passage of salmonids from the Yellowstone River to upstream spawning site in the smaller tributaries. Adverse Effects: Increased turbidity during installation.	Not Available.	Not Available.
Flow Regimen Improvement of Tributary Streams above Livingston.	Not Available.	Provision of more adequate instream flows would improve trout habitat in these tributaries.	Not Available.	Costs to landowners may be incurred in instituting better water conservation and land use measures.
Antelope Creek Storage Park County	First Cost $9,606,000 Annual Benefits Unknown Annual Costs 621,700 Net Benefits Unknown	Beneficial Effects: Provision of adequate instream flows for fish and wildlife during summer and fall in Shields River. Adverse Effects: Visual effects of dam and canal. Loss of Flora and Fauna in reservoir area.	Not Available.	Beneficial Effects: Benefits would accrue to locality from employment and other short term secondary benefits. The reservoir would also provide some recreational benefits to individuals. Adverse Effects: Loss of agricultural income in reservoir area. Impact of construction workers and families.
Management of Yellowstone River Islands to Improve Goose and Wildlife Habitat	Not Available.	Proper management would increase the goose population in the basin. Other types of wildlife utilizing the island would benefit also.		Benefits would accrue from additional recreational benefits stemming from increased hunting opportunities.
Wheat Basin and Broadview Wildlife Refuges Stillwater and Yellowstone Counties	Not Available.	Provision of a constant water supply for existing wildlife refuges while allowing for development of new refuges.	Not Available.	Not Available.

Table VII-1 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FISH AND WILDLIFE (Cont.) Classify the Beartooth and Absaroka Primitive Areas as a Wilderness Area	Not Available.	Maintain a unique natural area in its natural state.	Not Available.	Not Available.
Instream Flows Compare the reservation requests of the Departments of Fish and Game and Health and Environmental Sciences. Take the highest flow in each case.	Beneficial Effects: Precludes increased municipal water treatment costs and costs to irrigator due to loss of quality. Adverse Effects: No new full services irrigation.	Preservation of existing fish and wildlife habitat and water quality. Prevents any further degradation.	Same as NED.	Beneficial Effects: Increased income for recreation oriented business. Adverse Effects: Potential negative effects on agricultural employment and expansion. Possibly limits industrial and domestic future uses of river water--again limiting income and employment.
WILD, SCENIC, AND RECREATIONAL RIVERS Yellowstone River Establish national wild and scenic river designation for the Yellowstone main stem from Gardiner to Pompey's Pillar - 225 miles.	First Cost $38,547,000 Annual Benefits 1/ 2,832,500 Annual Costs 3,323,700 Net Benefits (491,200) 2/ 1/ Hunting and fishing benefits that have not been provided and are not included. 2/ The parentheses indicate a negative number.	The natural beauty along these reaches of streams will be preserved for present and future generations. Water quality will be improved. Flora and Fauna habitat values will be protected. A higher level of recreation use will be offset by better protection of the resource.	Tourism is a major contributor to the area and State economies. Recreation benefits resulting from preservation of these river reaches is in the state/regional interest. Other analysis is not available.	The pleasures associated with river-oriented recreation are important to social well-being. Local residents as well as tourists relax and revitalize themselves through their association with the pleasures provided by nature

Table VII-1 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Upper Yellowstone, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
WILD, SCENIC, AND RECREATIONAL RIVERS (Cont.)				
Boulder River Establish State recreation river designation for the Boulder River - Upside-Down Creek to confluence with the Yellowstone River - 58 miles (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $4,130,000 Annual Benefits 283,500 Annual Costs 385,800 Net Benefits (102,300)2/	The natural beauty along these reaches of streams will be preserved for present and future generations. Water quality will be improved. Flora and Fauna habitat values will be protected. A higher level of recreation use will be offset by better protection of the resource.	Tourism is a major contributor to the area and State economies. Recreation benefits resulting from preservation of these river reaches is in the state/regional interest. Other analysis is not available.	The pleasures associated with river-oriented recreation are important to social well-being. Local residents as well as tourists relax and revitalize themselves through their association with the pleasures provided by nature.
Shields River Establish State recreation river designation for the Shields River - Flathead Creek to confluence with the Yellowstone River - 40 miles. (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $6,568,000 Annual Benefits 195,500 Annual Costs 507,000 Net Benefits (311,500)	Same as above.	Same as above.	Same as above.
Stillwater River Establish State recreation river designation for the Stillwater River - 20 miles above U.S. Forest Service Woodbine Campground to confluence with the Yellowstone River - 65 miles. (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $4,964,000 Annual Benefits1/ 317,700 Annual Costs 454,500 Net Benefits (136,800) 1/ Hunting and fishing benefits that have not been provided and are not included. 2/ The parentheses indicate a negative number.	Same as above.	Same as above.	Same as above.

CHAPTER VIII

RECOMMENDED PLAN EVALUATION

The remaining needs were defined and presented in Chapter V; the purpose of this chapter is to see how well the elements of the Recommended Plan satisfy those needs.1/

Some needs appear to be in direct conflict (e.g., instream flows vs. expansion of irrigated agriculture). Others seem to be fairly compatible (e.g., scenic/recreational rivers and expansion of irrigated agriculture). Since economic development and environmental quality are equal partners in the planning process, there is inevitably competition for resources. Although there are projects and programs that will enhance or maintain the environment in this report, the effects of economic development inevitably add to the pressures on the environment. On the other hand, most economic development and especially coal/energy development is in the national interest, even though it has detrimental effects on the environment.

An evaluation of the plan, by functional area, is summarized in the following paragraphs.

Agriculture

The forecasts used for agriculture have been previously discussed in Chapters IV and V. Table V-2 has shown the possible limits to irrigated acreage according to those forecasts and the probable F/WO situation.

In the face of the very large difference between the upper and lower

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1/ Since the energy portion of the Recommended Plan is very close to the Harza "most probable" forecast, estimates of certain needs should also be based on the "most probable" population level (e.g., municipal/domestic consumption and outdoor recreation) shown in Chapter IV.

limits shown by the table, the recommended plan strikes a fairly conservative stance. The four proposed irrigation projects would irrigate a total of 14,240 new acres; however, the majority of these projects have been scheduled for the year 2000 (see Chapter VII) because there appears to be no immediate need for new State or federally sponsored irrigation projects. It appears that private irrigation development will be able to meet future needs (at least through 1985) for agricultural commodities, and will expand or contract according to market conditions.

Flood Control

Storage projects included in the Recommended Plan would provide flood control benefits for two of the Yellowstone tributaries (Shields River and Pryor Creek). Generally, flood plain zoning, flood insurance programs, land conservation measures, and preparedness programs (e.g., civil defense) are preferred to structural measures (see recommendations in Chapter X).

Outdoor Recreation

The placement of the Upper Yellowstone River into the National Wild and Scenic River System and protection of portions of the Shields, Boulder, and Stillwater Rivers by State designation, would allow opportunity for increased public recreational use of a total of 388 miles of quality streams.

New flat-water recreational acres would be provided by the construction of the three storage projects found in the recommended plan, but stream recreation areas would be lost.

Land Conservation

The Plan includes an accelerated land conservation program that would for mechanical and managerial conservation measures on one-half of the Federal and non-Federal lands that would not have been included under existing programs. By the year 2000, 92 percent of the lands needing conservation measures would be treated under the accelerated program at an additional capital cost of about $19,460,000.

The streambank greenbelt program would aid in stabilizing streambank erosion problems while concurrently maintaining riparian wildlife habitat.

Fish and Wildlife

Of the plan elements that would benefit fish and wildlife, provisions for minimum instream flows are the most bitterly debated. The effects of the F/WO and recommended plan consumptive uses on these proposed minimum flows are shown in the Hydrological Supplement.

Other fish and wildlife elements (structural and non-structural) would maintain and/or enhance existing habitat, with the exception of the Wheat Basin and Broadview waterfowl refuge proposal which would create new habitat.

Other Functional Areas

The needs of the other functional areas (see Chapters IV and V) will be met by the F/WO situation as discussed previously in Chapter V.

Cost of the Program

Implementation of all of the elements in the Recommended Plan would bring

new capital expenditures of approximately $107.63 million into the Upper Yellowstone Planning Area. The total is differentiated by project type in Table VIII-1.

Table VIII-1. Capital Costs, Recommended Plan, Upper Yellowstone, Montana

Project Type	$ Millions
Multi-purpose	6.59
Single Purpose	16.57
Outdoor Recreation	55.39
Land Conservation	19.46 1/
Fish and Wildlife	9.62 1/
Total	107.63

1/ Capital costs are not available for all fish and wildlife and land conservation projects.

Annual costs and benefits that would accrue by project type are shown in Table VIII-2. SRD Benefits are included.

Table VIII-2. Annual Costs and Benefits, Recommended Plan, Upper Yellowstone, Montana

Project Type	$ Millions	
	Annual Costs	Annual Benefits
Multi-purpose	0.46	0.55
Single Purpose	1.21	1.79 1/
Outdoor Recreation	4.75	3.80 2/
Land Conservation	1.58	1.58 3/
Fish and Wildlife	0.62 4/	4/
Totals	8.62	7.72

1/ Includes SRD regional benefits.

2/ Does not include direct benefits from hunting and fishing.

3/ Assumes that costs equal benefits under the Accelerated Land Conservation Program. Costs and benefits are not available for all land conservation programs.

4/ Benefits and costs are not available for fish and wildlife projects.

Table VIII-3 shows costs allocated by function, which better describes the mix of Plan elements. These costs were allocated by using the Separable Costs-Remaining Benefits method prescribed for use in this Level B Study.

Table VIII-3. Summary of Capital Cost by Function, Recommended Plan, Upper Yellowstone, Montana

Function	$ Millions
Irrigation	23.06
Flood Control	0.10
Outdoor Recreation	55.39
Fish and Wildlife	9.62 1/
Land Conservation	19.46 1/
Total	107.63

1/ Costs are not available for all fish and wildlife and land conservation proposals.

CHAPTER IX

IMPACTS OF THE RECOMMENDED PLAN

The purpose of this chapter is to compare the impacts stemming from the elements found in the Recommended Plan to the present (1975) and/or the F/WO situations.[1/] However, the reader is reminded that there are elements of the plan that are in direct conflict (e.g., instream flows vs. water consumptive types of development). These conflicts, shown by the Hydrology Supplement, can be resolved only after the reservations for future use of Yellowstone water have been established by the State of Montana.

Population

Of the impacts associated with the Recommended Plan, population increases are probably one of the most significant, because of their effects on social, health, and educational services, as well as other environmental and economic resources. As explained in the preceding chapter, the "most probable" population projection (first shown in Chapter IV, Table IV-7) best represents the population effects stemming from the elements of the Recommended Plan and the F/WO developments that are expected. Table IX-1 illustrates the magnitude of the anticipated population changes in this area. These figures take into account coal/energy development in Eastern Montana and its indirect impact on the Upper Yellowstone Planning Area. The table shows a population increase of 39,800 or 34 percent, by the year 2000.

1/ Comparisons of the NED, EQ, and Recommended plans are shown in Chapter VIII of the main report--Yellowstone Level B Study Report--which treats the three States and seven planning areas as a whole.

Table IX-1. Population Changes, 1975-2000, Upper Yellowstone, Montana1/

Population	1975	1985	2000
Totals	117,700	141,300	157,500
Differences: 1975		23,600	39,800

1/ Rounded to nearest hundred.

Water Consumption

Table IX-2 shows the major water consuming sectors of the Upper Yellowstone area. These sectors have been previously described in Chapters IV and V. The table shows an increase in water consumption of 118,325 af/y over the 1975 level of development; 94 percent of the increase (111,021 af/y) would come from expanded private (F/WO) and public irrigation projects.

Table IX-2. Additional Water Consumption by Sector, Recommended Plan Plus F/WO 1975-2000, Upper Yellowstone, Montana1/

Sector	Consumption of af/y
Irrigation2/	105,773
Energy	---0---
Domestic/Municipal	2,302
Industrial	1,400
Non-Energy Minerals	702
Livestock3/	2,900
Total	113,077

1/ Given implementation of all projects, disregarding minimum instream flows.

2/ An increase of 39,210 af/y over the F/WO.

3/ Includes evaporation.

Implementation of the proposed irrigation projects found in the Recommended Plan accounts for the consumption of 36,000 af/y, or 32 percent of the total additional water requirements at the year 2000.

Land Use

The largest change in land use patterns over the next 25 years would probably be due to expanded irrigation, given favorable market conditions for agricultural products. Additional lands totaling (F/WO + Recommended Plan) 47,198 would be brought under irrigation by the year 2000. Of that total, 31,250 acres would probably be privately (F/WO) developed, while nearly 16,000 are proposed to be developed with public funds. Table IX-3 illustrates the land use changes associated with elements of the Recommended Plan.

Some of the plan elements involve land use protection rather than land use changes. For example, the Beartooth Wilderness Area would encompass 613,500 acres in this area and 300,000 in the adjacent Clarks Fork-Bighorn Area. The development of wild, scenic, and recreational rivers would entail the purchase of easements on 75,000 acres of private lands.

Environment

Table IX-4 presents the Plan element impacts on the environment. Little of the data from these projects is available in a quantifiable form, so they are presented in the descriptive manner shown below. Instream flows would be affected by new irrigation developments and population growth; those quantitive effects can be seen in the Hydrology Supplement.

Table IX-3. Identified Land Use Changes Stemming from Recommended Plan, 1975-2000, Upper Yellowstone, Montana

Project or Program	Net Land Use Changes										
	Acres									Other	
	Irrigated Cropland and Pasture	Non-Irrigated Cropland and Pasture	Forest and Woodland	Urban	Rangeland	Water Surface	Private	Public	Streambank (Acres)	Streambank (Miles)	Other
Multipurpose	9,440	-9,440	1/	--	1/	1,250	1/	1/	-1,250	-4	--
Single Purpose	6,508	-6,508	1/	--	1/	--	1/	1/	--	--	--
Land Conservation	1/	1/	1/	--	1/	--	--	--	1/	1/	1/
Fish and Wildlife	1/	1/	1/	--	--	940	1/	1/	-560	-6	--
Beartooth Wilderness Area	--	--	613,500	--	1/	--	1/	1/	--	--	1/
Instream Flows	--	--	--	--	--	--	--	--	--	--	1/
Wild, Scenic, and Recreational Rivers	--	--	--	--	--	--	-314	+314	75,372 2/ 3/	388	--
Population	--	--	--	1/	--	--	--	--	--	--	1/

1/ Land use changes not determined.

2/ Easements total 75,058 acres.

3/ Represents a change in management rather than in land use.

Table IX-4. Identified Environmental Impacts Stemming from the Recommended Plan, 1975-2000, Upper Yellowstone, Montana

Environmental Impacts	Projects or Programs							
	Multipurpose	Single Purpose	Land Conservation	Fish and Wildlife	Beartooth Wilderness Area	Minimum Instream Flows	Wild, Scenic, and Recreational Rivers	Population
Open Space and Greenbelts (Acres)	0	0	+	+	+	0	+	-
Creation of Fish and Wildlife Habitat (Acres)	+	0	+	+	0	0	0	0
Improvement or Stabilization of Existing Habitat (Acres)	0	0	3/	+	+	+	+	-
Wilderness, Primitive, and Natural Areas (Acres)	0	0	0	+	613,500	0	+	0
Instream Flow Values (Acre-Feet)	-	-	+	+	+	4/	+	-
Native Species (Flora and Fauna)	-	-	+	+	+	+	+	-
Water Quality--TDS (Mg/L)	2/	2/	+	0	0	0	0	-
NO_x (1000 Tons)	0	0	0	0	0	0	0	0
SO_x (1000 Tons)	0	0	0	0	0	0	0	0
Particulates (1000 Tons)	0	0	0	0	0	0	0	0
Streams (Miles)	-4	0	+	-2	0	0	388	0

1/ The nature of the entries of this table illustrate the lack of data related to environmental effects; (-) indicates negative effect, (+) indicates positive effect, and (0) indicates minimal effect.

2/ See Hydrology Supplement for these values.

3/ See Chapters VII and VIII.

4/ See Chapters IV and V.

Outdoor Recreation

The Recommended Plan contains a proposal to form a Beartooth Wilderness Area, three proposals for new reservoirs, and four proposals for wild, scenic or recreational rivers. Table IX-5 illustrates the increased opportunities for outdoor recreation due to these elements. The land and water areas translate into a least 540,780 additional recreation days, and 187,000 fishing days, upon implementation of these proposals. Since the Upper Yellowstone Planning Area is and will continue to be the most densely populated area in the Yellowstone Basin, these opportunities are sorely needed. Even with the proposed additions, it is estimated that there will be a shortage of another 1,582,000 recreation days needed by the area's population. Adjacent areas can only supply roughly one-third of those needs.

Table IX-5. Identified Recreation Impacts Stemming from the Recommended Plan, 1975-2000, Upper Yellowstone, Montana

Projects	Land Area (Acres)	Water Area (Acres)	Streams (Miles)	Recreation Days	Fishing Days
Reservoirs	1/	1,810	-6	238,000	187,000
Wild, Scenic, and Recreational Rivers	75,372	1/	388	302,780	
Beartooth Wilderness Area	613,500	1/	1/	1/	1/
Totals 2/	688,872	1,810	382	540,780	187,000

1/ Undetermined.

2/ Only partial totals.

Economic Impacts

The economic impacts that would stem from elements of the Recommended Plan are varied and related to the alternative uses that could be put to

the area's water resources by the year 2000. However, impacts from the Recommended Plan would be minor in comparison to F/WO development (e.g., expansion of irrigated agriculture, development of the Stillwater Complex, or secondary impacts from coal/energy development in Eastern Montana).

Future development of the agricultural, recreational, metallic mineral, land fish and wildlife resources in the Upper Yellowstone Area are tied to the water reservation issues that exist throughout the Yellowstone Basin (see Chapter II). The Montana Board of Natural Resources and Conservation is faced with the task of allocating the Basin's water in an economically <u>and</u> environmentally rational manner that will account for the <u>value</u> of the product that requires the use of the water. The product with the greatest net value should receive a priority allocation--other things being equal. Additional <u>consumption</u> of water by any sector will have the effect of destroying portions of the area's existing river and riparian habitat. When the value of the last environmental unit destroyed equals the value of the last economic unit produced, additional water depletions should be ended.

CHAPTER X

CONCLUSIONS AND RECOMMENDATIONS

The conclusions presented below summarize some of the salient facts garnered from the Level B effort in Montana. The recommendations present the Study Team views on actions that need to be taken if resource development, conservation, and preservation are to be most effective in the years ahead.

The conclusions and recommendations for all of the four Montana planning areas have been combined into this Chapter for the convenience of the reader. This obviates the need for the reader to piece together the individual planning area reports in order to put the entire study into a basinwide perspective.

Conclusions

1. Total additional water consumption (associated with the Plan) in the Yellowstone Basin by the year 2000 will vary from the low option of 350,000 acre-feet per year (af/y) to the Recommended Plan level of 612,000 af/y, depending upon how the instream flow issue is ultimately settled. In this time period, additional water consumed by irrigation will be from 2 to 7 times that of coal/energy uses.
2. The United States has a need for coal/energy production. Montana has substantial coal resources that can help in meeting the national need.
3. It appears that the State's citizens support the State's official coal export "policy" as opposed to in-state conversion of coal to other forms of energy.

4. Export by slurry pipeline consumes less Montana water than conversion of coal to electricity (water-cooled plants) or synthetic gas.
5. Export of coal by rail consumes a negligible amount of water but it adds a burden to land owners and citizens of small communities that cannot gain access to areas "across the tracks," due to the railway traffic. In addition, railway traffic has some air and noise pollution associated with it.
6. Total coal/energy related water consumption in the Basin could range anywhere from 83,000 af/y to 219,000 af/y at the year 2000, depending on the level of development (the Study Teams recommend the lesser; see Chapter VII of the Tongue-Powder and the Lower Yellowstone Reports).
7. Lack of agricultural production is not foreseen to become a major problem in either the Nation or the Yellowstone Basin by the year 2000; private irrigation ventures are expanding, at present, but there does not appear to be a great need for new State or Federal irrigation projects until after 1985 and perhaps not until 2000--depending on market conditions.
8. The 3E projections (based on OBERS E and E' forecasts, see Chapter IV) have indicated a need for increased roughage production to support future expanded cow/calf operations. However, it is unclear whether or not income from hay and alfalfa in conjunction with cow/calf operations can match the costs of bringing substantial land areas under irrigation.
9. No mainstem Yellowstone River reservoir will be needed within the time frame considered in this study.
10. Lack of access is a major recreation problem.
11. Scenic and recreational river designations will not adversely affect or interfere with senior water rights.

12. Outdoor recreation will be of increasing importance in the area, partly as a result of anticipated population increases in the major energy-resource development areas.

Recommendations

The following recommendations are presented as part of the Recommended Plan discussed previously in Chapter VII. The recommendations result from the Study Team's analysis and consideration of problems that may be confronted in moving the plan from the inactive stage to one where it can be used as a flexible guide for future water and related land resource management in the Yellowstone Basin.

Miscellaneous

1. The State of Montana should identify Montana streams of major significance and provide appropriate protection for those streams to supplement the National Wild and Scenic Rivers System.
2. The Yellowstone Compact should be amended to recognize minimum instream flow and water quality values.
3. The Yellowstone River should remain a free-flowing river.
4. Indian and Federal "reserved" water rights should be defined, quantified, and adjudicated at the earliest possible date.

Coal Impacts

1. The Montana State Legislation should reconsider the ban on the use of water in interstate slurry pipeline operations. Such a mode of transportation could supplement rail traffic in the export of Montana coal to the demand regions.

2. The General Accounting Office should audit federally funded stripmine reclamation research projects. The object of this audit would be to identify duplication of effort and note areas not being adequately studied.
3. An evaluation study and public information program should be undertaken by the Department of Interior to illustrate opportunities and techniques for making mineral ownership exchanges between Federal, State, and/or private land owners in order to mitigate potential environmental problems associated with coal production.
4. In order to meet future energy demands, Congress should: (1) adopt a national energy conservation program designed to reduce current and projected energy demands; and (2) provide additional funds for development of innovative renewable energy programs.

Flood Damage Reduction

1. State and Federal land management agencies, in conjunction with private landowners, should institute best management practices in order to retard runoff and reduce flood hazards throughout the study area.
2. City and county governments should continue to improve flood preparedness, and act to ensure adequate and operable flood warning systems.
3. The Congress should continue funding the installation of selected river management projects using variations of different types of structural bank protection measures at 24 key locations between Intake, Montana, and the mouth of the Yellowstone River. These measures should be coordinated with other Federal and State agencies to assure that existing recreational fish and wildlife, and esthetic resources are not adversely affected.1/

1/ See Fish and Wildlife comments that follow.

4. The Corps of Engineers West Billings Flood Control Project is not included in the plan elements. Instead the Study Team has recommended a non-structural approach to the flood problem (e.g., flood plain zoning and flood insurance programs).

Irrigation and Industrial Development

1. Federal, State, and local agencies should continue to support and provide technical and financial assistance to landowners in identifying and applying good land and water conservation practices.
2. Strategic off-stream storage sites should be selected and evaluated at a feasibility level to see if such projects can be supported by potential users in the future.

Fish and Wildlife

1. The Broadview-Wheat Basin wildlife refuges should be further developed; plans for improvement should reflect the potentials of the Billings Water/Calamity Jane Project.
2. A study should be made to determine if the diversion structure in the Yellowstone River at Intake, Montana, should be modified to allow for passage of paddlefish. This could reduce the amount of water required for fish and wildlife needs in that reach of the river. Other diversions in the basin might benefit from modifications for fish passage.
3. In a number of tributaries, trout habitat is severely degraded by irrigation diversions in late summer. A study should be made to locate and evaluate off-stream damsites in which water could be stored during periods of excess flow and released to augment the flow during the summer months. The proposed project on Shields River is an example (Antelope Creek Storage).

Domestic and Municipal Water Supply

1. State, county, and local agencies responsible for providing or regulating domestic water supplies in the Yellowstone River Study Area should take advantage of provisions of Federal Safe Drinking Water Act, P.L. 93-523, in order to receive cost sharing and other benefits that would aid in improving domestic water quality.
2. Programs should be accelerated to aid in the discovery and delivery of water to water-short rural communities in Eastern Montana.

Land Conservation

1. The Soil Conservation Service and other State and Federal land management agencies should formulate and implement best management practices throughout the Yellowstone Basin to reduce man-caused sediment and related problems.
2. Overutilized private and public lands in the Shields River Drainage should be inventoried and then managed to achieve rehabilitation of soils, vegetation, and water quality. Organizations such as the Soil Conservation Service and Forest Service should contribute to the effort within the scope of their responsibilities.

Water Quality

1. A method(s) should be devised whereby the costs imposed by a degradation of water quality on present users can be determined, and considered as a cost of future development.
2. The water quality changes brought about by large withdrawals of water and associated return flows should be evaluated more thoroughly by appropriate State and Federal agencies, and the study results should be published as a part of project development impact data.
3. Montana's water quality surveillance system should be evaluated to see if it can meet the demands that will be placed on it with growth of the State's economy.

General Environment

1. The Water Resources Council should be provided the authority to ensure that all Federal water planning agencies, including those dealing directly with the environment, will actively participate in multipurpose planning efforts. State agencies that have responsibilities related to water resources should alse be required to actively participate in State-Federal cooperative studies.
2. Significant archaeological and historical sites in the study area should be identified and preserved.
3. The Congress and State Legislature should be encouraged to fund badly needed Environmental Quality projects, even though calculated benefit-cost relations are unfavorable.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

August 30, 1977

Mr. Martin Oleson, Study Manager
Montana State Study Team
Missouri River Basin Commission
404 North 31st Street - Room 332
Billings, MT 59101

Dear Mr. Oleson:

We have received a draft copy of chapter ten, "Conclusions and Recommendations," for the Montana portion of the Yellowstone Level B study. Recommendation number three under the "Flood Damage Reduction" section indicates the study team is urging Congress to continue funding the Erosion Control and Demonstration program for the Yellowstone River - Intake, Montana to the mouth which was authorized by the Streambank Erosion Control and Demonstration Act of 1974, plus amendments.

We wish to record our objections to this recommendation based on probable losses to fish and wildlife resources if the program is carried out. Our analysis of this entire program was outlined in a letter dated August 15, 1977, to the Corps of Engineers. A copy of that letter is enclosed for your information.

Sincerely,

Burton W. Rounds

Burton W. Rounds
Area Manager

Enclosure
cc: Regional Director, FWS. Denver, CO (ENV)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MAILING ADDRESS
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION
10597 West Sixth Avenue
Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO:

ENV

AUG 15 1977

District Engineer
Attention: R. C. Burnett, P.E.
Chief, Engineering Division
Omaha District, Corps of Engineers
6014 U.S. Post Office and Courthouse
Omaha, NE 68102

Dear Sir:

This letter contains U.S. Fish and Wildlife Service (FWS) preliminary comments on the Corps of Engineers document entitled, "Erosion Control Demonstration Program for the Yellowstone River - Intake, Montana to the Mouth," transmitted to us by your letter dated March 15, 1977.

Authorization for the proposed bank stabilization demonstration projects on the Missouri River was granted under Section 32 of the Water Resources Development Act of 1974. Section 155 of the 1976 Omnibus bill amended the original bill by adding two additional reaches of rivers for construction of demonstration projects. The lower Yellowstone River from Intake, Montana, to its mouth was one of the rivers added. Our comments on the proposal were prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661 et seq.).

The project area was inspected by air on April 7, 1977, by members of this office and the Billings Area Office. Preliminary ground inspection of individual project sites within Montana was conducted on April 19 and 20, 1977, with the cooperation of Montana Fish and Game Department personnel. Project sites in North Dakota were inspected on May 5, 1977, by personnel of the Billings and Bismarck Area Offices of the FWS and the North Dakota Game, Fish and Parks Commission.

This letter briefly discusses the existing situation for fish and wildlife in the area, the erosion problem generally, and the Corps' proposed solution as reflected by the Demonstration Program. An analysis of impacts is presented along with recommendations for acceptable demonstration sites and possible alternative actions.

The Yellowstone River within the project area generally has a large, braided stream channel with many islands, side channels, extensive backwaters, cutoff oxbow lakes, and sand or gravel bars. This stream form is the result of dynamic, ongoing channel formation and adjustment processes. A consequence

The proposed solution includes 24 individual bank stabilization projects designed to prevent erosion and loss of croplands, and man-made structures. The "demonstration" would cost an estimated $3,840,000 to stabilize approximately 26.7 miles of bank along the lower 63 miles of the Yellowstone River (13.8 miles of bank stabilization on Montana and 12.9 miles in North Dakota). Approximately one third of the project sites would protect constructed facilities such as roads, bridges, or irrigation structures; the remainder would primarily protect agricultural lands from natural erosion.

It is the general policy of the Fish and Wildlife Service not to object to the construction of stream alteration projects that are planned with due attention to environmental values. The Service policy is to consider favorably those stream alteration projects which meet the following conditions: 1) The proposal is clearly demonstrated, by substantial evidence, to be warranted in the public interest to protect human life, health, safety, or welfare; and 2) all alternatives to the proposal have been evaluated, and it has been clearly demonstrated to the satisfaction of the Service that none are feasible which could accomplish the demonstrated public need. However, we cannot support such projects where there would be significant damage to fish and wildlife resources and would have only localized, mainly private benefits to a relatively few people.

Implementation of the proposed project would result in cumulative and long-term adverse impacts to wildlife resources. An overall loss of wildlife habitat (primarily brush and tree habitat types) could be expected to occur at an accelerated pace as stabilized lands are cleared and cultivated as a result of protection from bank erosion and the related cycles of land accretion and serial vegetative succession. Bank stabilization on the lower Missouri River and many other streams has demonstrated that such land use changes are induced following bank stabilization projects. That is, once the river banks are stabilized, it becomes feasible for private landowners to clear brush and bottomland forest habitats and put these areas to intensive agricultural use. This indirect impact of bank stabilization has the potential to damage wildlife habitat much more than the direct losses associated with project construction and maintenance. Additional habitat losses can be postulated as an accumulative reduction in anabranches, backwaters,and similar habitat niches takes place.

Still another indirect loss of wildlife habitat may occur downstream from individual project demonstration sites, impacting primarily islands and lands immediately adjacent to the river channel. This could come about if the river channel, now directed at a stabilized bank, becomes redirected into an island or shoreline not protected by the project, thus eroding those banks.

The FWS is prepared to work with the Corps if the Demonstration Program proceeds despite our objections. Certainly, it will be necessary to arrive at acceptable wildlife mitigation measures for individual projects and the cumulative losses associated with this proposal if construction proceeds.

In the past, we agreed to implementation of the portion of the Bank Stabilization and Demonstration Program on the Missouri River without the preparation of an Environmental Impact Statement. However, this was done with the clear understanding that information gained from that experimental project would be used to make decisions regarding future bank stabilization measures. It now appears to us that the Bank Stabilization and Demonstration Program, as proposed on the Lower Yellowstone River, is of such magnitude that it constitutes a major Federal action affecting the quality of the human environment. Thus, an environmental impact statement should be prepared for this portion of the program. This would permit the discussion of nonstructure alternatives such as we have presented in this letter.

Please contact our Billings Area Office for additional consultation and planning assistance.

Sincerely yours,

Marvin P. Duncan

Marvin P. Duncan
Acting Regional Director

cc: Bismarck Area Office
U.S. Fish and Wildlife Service
Department of Interior
P.O. Box 1897
Bismarck, North Dakota

Montana Fish and Game Department
Helena, Montana 59601

North Dakota Fish and Game Department
2121 Lovett Avenue
Bismarck, North Dakota 58501

United States Department of the Interior

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Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO

ENV

AUG 15 1977

District Engineer
Attention: R. G. Burnett, P.E.
Chief, Engineering Division
Omaha District, Corps of Engineers
6014 U.S. Post Office and Courthouse
Omaha, NE 68102

Dear Sir:

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The project area was inspected by air on April 7, 1977, by members of this office and the Billings Area Office. Preliminary ground inspection of individual project sites within Montana was conducted on April 19 and 20, 1977, with the cooperation of Montana Fish and Game Department personnel. Project sites in North Dakota were inspected on May 5, 1977, by personnel of the Billings and Bismarck Area Offices of the FWS and the North Dakota Game, Fish and Parks Commission.

This letter briefly discusses the existing situation for fish and wildlife in the area, the erosion problem generally, and the Corps' proposed solution as reflected by the Demonstration Program. An analysis of impacts is presented along with recommendations for acceptable demonstration sites and possible alternative actions.

The Yellowstone River within the project area generally has a large, braided stream channel with many islands, side channels, extensive backwaters, cutoff oxbow lakes, and sand or gravel bars. This stream form is the result of dynamic, ongoing channel formation and adjustment processes. A consequence

of the existing channel formation is a large quantity and high quality and diversity of riverine wildlife habitat largely unequalled in this region. Besides a diversity and large number of game mammals and birds occupying this habitat, many nongame species occur including, for example, beavers, wintering eagles, and a myriad of migrating and nesting song birds.

This highly productive fish and wildlife resource area is maintained within and is largely dependent upon the naturally functioning floodplain of the Yellowstone River. There are areas within this floodplain where uplands are being eroded by the river channel (Figure 1), while other areas are being filled in by silt deposition. The lands created by sediment deposition at first support a growth of willow and young cottonwood trees (Figure 2). Then, as time passes and the river channel traverses the floodplain, the newly accreted lands may become a forest of mature cottonwood trees. This bottomland forest in turn succumbs to bank erosion as the river channel returns to its original side of the floodplain. It is largely this continuous process which establishes and maintains the diversity of channels, islands, and differing bank conditions that create the range of habitats and abundance of wildlife present in the lower Yellowstone River.

A stated purpose of the Demonstration Program is to provide basic information on the extent and nature of erosion problems along the lower Yellowstone River and to evaluate the potential solutions for such problems. The erosion problem results from a naturally functioning river system eroding floodplain lands, thus threatening "vital irrigation facilities . . . , prime cropland and other vital facilities such as roads, bridge abutments, power lines, and municipal sewer and water plants." The Montana Department of Natural Resources and Conservation (DNRC) concluded in its EIS for Water Reservation Applications in the Yellowstone River Basin that: "The impact of several decades of water diversion on the morphology of the Yellowstone mainstem has been small, principally because the mainstem is still essentially free flowing . . . . The major influence on channel morphology has been riprap, which stabilizes the banks and limits the operation of natural processes." Thus, solution of the erosion problem creates a conflict between the need to limit the natural processes of the stream by stabilization of its banks and the need to allow the river to function in its dynamic fashion.

The Corps' proposed solution to the erosion problem was formulated by a technical review board composed of agricultural interests, the Bureau of Reclamation, and the Corps of Engineers. The review board concluded that "a comprehensive erosion monitoring and control plan should be developed for the entire reach" of the Yellowstone River within the project area. The review board then selected demonstration sites and design criteria and determined four erosion control techniques to be applied.

The proposed solution includes 24 individual bank stabilization projects designed to prevent erosion and loss of croplands, and man-made structures. The "demonstration" would cost an estimated $3,840,000 to stabilize approximately 26.7 miles of bank along the lower 63 miles of the Yellowstone River (13.8 miles of bank stabilization on Montana and 12.9 miles in North Dakota). Approximately one third of the project sites would protect constructed facilities such as roads, bridges, or irrigation structures; the remainder would primarily protect agricultural lands from natural erosion.

It is the general policy of the Fish and Wildlife Service not to object to the construction of stream alteration projects that are planned with due attention to environmental values. The Service policy is to consider favorably those stream alteration projects which meet the following conditions: 1) The proposal is clearly demonstrated, by substantial evidence, to be warranted in the public interest to protect human life, health, safety, or welfare; and 2) all alternatives to the proposal have been evaluated, and it has been clearly demonstrated to the satisfaction of the Service that none are feasible which could accomplish the demonstrated public need. However, we cannot support such projects where there would be significant damage to fish and wildlife resources [illegible], mainly private benefits to a relatively few people.

Implementation of the proposed project would result in cumulative and long-term adverse impacts to wildlife resources. An overall loss of wildlife habitat (primarily brush and tree habitat) would be expected to occur at an accelerated pace as stabilized lands are cleared and cultivated as a result of protection from bank erosion and the related cycles of land accretion and serial vegetative succession. Bank stabilization on the lower Missouri River and many other streams has demonstrated that such land use changes are induced following bank stabilization projects. That is, once the river banks are stabilized, it becomes feasible for private landowners to clear brush and bottomland forest habitats and put these areas to intensive agricultural use. This indirect impact of bank stabilization has the potential to damage wildlife habitat much more than the direct losses associated with project construction and maintenance. Additional habitat losses can be postulated as an accumulative [illegible] sloughs, backwaters, and similar habitat niches takes place.

Still another indirect loss of wildlife habitat may occur downstream from individual project demonstration sites, impacting primarily islands and lands immediately adjacent to the river channel. This could come about if the river channel, now directed at a stabilized bank, becomes redirected into an island or shoreline not protected by the project, thus eroding those banks.

The most significant threat here may be that additional bank stabilization measures could be encouraged. However, potential direct losses of habitat, in some instances, are relatively great as on Crittenden and Seven Sisters Islands.

It appears that several of the selected demonstration sites are designed to protect man-made structures that are not in immediate danger from erosion or are of a nonessential nature. The majority of the proposed sites, moreover, would primarily protect "agricultural" lands from natural erosion. Many of these latter projects will result in secondary clearing of floodplain vegetation and replacement by cultivated crops and other impacts as previously outlined. The FWS cannot support such stabilization proposals which would have only localized, mainly private benefits to a relatively few people and would result in significant damage to fish and wildlife resources. In these cases, the FWS recommends adoption of floodplain management programs in preference to stream channel alteration via bank stabilization measures.

Our cursory inspection of the 24 proposed projects revealed that only four have a clear potential to be in the general public interest: the Sidney Bridge Area, River Road Area, Cartwright Bridge Area, and the Upper Sioux Area. These four projects would protect existing bridges, roads, or irrigation structures (Figure 3). However, even these four projects appear to call for more construction than is needed to protect only the vital facilities. That is, they appear to include protection of associated agricultural lands. Thus, modification of these proposed structures appears warranted.

The 20 remaining projects in the program are unacceptable to the FWS because of potential losses to fish and wildlife resources. In this connection, and as previously noted, the basic stated purpose of the Demonstration Program is to demonstrate and evaluate potential solutions to the bank erosion problem. The Corps already has bank stabilization demonstration projects at several other locations in the Missouri River drainage in North and South Dakota and Nebraska. We recommend that before initiation of the Yellowstone River project, these ongoing demonstrations and other existing bank protection works be fully evaluated to determine their cumulative economic and environmental effects. The magnitude of potential wildlife habitat loss is too great on the lower Yellowstone River to be sacrificed for demonstration purposes, especially when other ongoing projects may achieve the same objective.

Our field inspections revealed that the Bureau of Reclamation also has numerous bank stabilization structures already in place in the lower Yellowstone River. The hard point system proposed for demonstration and evaluation by the Corps exists (at least functionally) at several locations (Figure 4). Some of the Bureau of Reclamation revetments also appear functionally similar to those proposed for evaluation by the Corps. An evaluation of these existing structures may meet some of the Corps objectives.

The FWS is prepared to work with the Corps if the Demonstration Program proceeds despite our objections. Certainly, it will be necessary to arrive at acceptable wildlife mitigation measures for individual projects and the cumulative losses associated with this proposal if construction proceeds.

In the past, we agreed to implementation of the portion of the Bank Stabilization and Demonstration Program on the Missouri River without the preparation of an Environmental Impact Statement. However, this was done with the clear understanding that information gained from that experimental project would be used to make decisions regarding future bank stabilization measures. It now appears to us that the Bank Stabilization and Demonstration Program, as proposed on the Lower Yellowstone River, is of such magnitude that it constitutes a major Federal action affecting the quality of the human environment. Thus, an environmental impact statement should be prepared for this portion of the program. This would permit the discussion of nonstructure alternatives such as we have presented in this letter.

Please contact our Billings Area Office for additional consultation and planning assistance.

Sincerely yours,

[illegible] P. Duncan
Acting Regional Director

cc: Bismarck Area Office
U.S. Fish and Wildlife Service
Department of Interior
P.O. Box 1897
Bismarck, North Dakota

Montana Fish and Game Department
Helena, Montana 59601

North Dakota Fish and Game Department
2121 Lovett Avenue
Bismarck, North Dakota 58501

STATE OF MONTANA

DEPARTMENT OF

FISH AND GAME

Helena, Montana
February 21, 1978

Missouri River Basin Commission
Suite 40 3, 10050 Regency Circle
Omaha, Nebraska 68114

Gentlemen:

We are attaching a copy of a letter sent to the Corps of Engineers regarding their proposals for streambank stabilization on the lower Yellowstone River in Montana. We would like you to consider this letter as our comment on item number 3 on page X-5 in the January 1978 Yellowstone Basin and Adjacent Coal Area Level B Study, Volume 3.

Sincerely,

Fletcher E. Newby
Deputy Director

FEN/RWB/gk
cc: Orrin Ferris
Keith Seaburg

Attachment

STATE OF MONTANA

DEPARTMENT OF
FISH AND GAME

Helena, Montana
September 6, 1977

Mr. R. G. Burnett, P.E.
Chief, Engineering Division
Army Corps of Engineers
6014 U.S. Post Office & Courthouse
Omaha, Nebraska 68102

Dear Mr. Burnett:

This correspondence concerns the Corps of Engineers' proposal entitled "Erosion Control Demonstration Program for the Yellowstone River, Intake, Montana to the Mouth." We wrote to your office on April 14, 1977, requesting information on this proposal, and you responded on May 4, 1977, including a description of project proposals.

Since that date we have inspected all of the sites in Montana where erosion control measures are proposed. This inspection included both the biological and engineering aspects of the proposal, and was performed by this department's and Montana State University personnel. We found, with minor exception, that streambank erosion was not significant enough to justify a program of this scope on even a demonstration and evaluation basis.

It was impossible to comprehend the rationale behind the selection of the proposed sites. In many instances, control structures are being proposed for areas on well vegetated, stable, or near stable banks. In other cases, extensive bank stabilization measures are planned for areas far removed from the main channel, and in one case, on an already diked off flood channel. If the proposed structures are installed and remain functional over any period of time, it will probably be the result of having placed them in areas of minimal erosive activity, rather than of the design of the structures themselves.

Cause of the erosion that now exists, including land clearing and cropping to the river's edge, previous bank stabilization attempts, geomorphology, and basic hydraulic functions, were not adequately identified or addressed in the report. It appears that individual sites were given only cursory field inspection, if any, before including them in the program.

-continued-

There also seemed to be only superficial consideration given to preserving wildlife habitat or other environmental values in areas where control structures are proposed. The outstanding wildlife values on this reach of the Yellowstone stem primarily from the densely vegetated riparian areas interspersed with agricultural lands, and stable islands of willow and cottonwood. On some project sites, much of the established wildlife habitat would be destroyed in the act of constructing the projects. At other sites, the stabilization practices would exert adverse hydraulic pressures on adjacent river banks or on established vegetated islands, most of which contain valuable wildlife habitat.

In light of the above and considering that a similar proposal has been made for sections of the Missouri River, and considering that numerous dikes, revetments, riprap, hardpoints, etc. have already been constructed on probably all of the nation's major rivers and streams (including this section of the Yellowstone River) and that most of these are available for evaluation, we can see no justification for your proposal.

Therefore, in our opinion, your proposal does not conform with the intent of the Fish and Wildlife Coordination Act in protecting wildlife and wildlife habitat, or with the legislative policies of the state of Montana to preserve streams in their natural condition, as is feasible and desirable.

We suggest that a better method of improving river bank conditions in this area would be to carefully remove and properly dispose of existing jacks which are no longer functional. These are esthetically about equal to car body riprap, and also pose distinct hazards to boat navigation. There should also be an intense public informational effort to advise local land owners of the erosion hazard in clearing and cropping land to the river's edge. At least two such projects are now underway with vegetation being disposed of on the river bank which are probably Section 10 or 404 violations.

In your correspondence of May 4, 1977, you pointed out the preliminary and provisional state of this proposal. We appreciate and acknowledge that fact, and hope our general comments at this time will serve to indicate our deep concern that the need for and the ramifications of the proposal need much greater in-depth investigation and public discussion. The Yellowstone River is a valuable natural asset to the State of Montana and should not be subjected to unnatural and unnecessary streambank manipulation.

Sincerely,

Robert F. Wambach

Robert F. Wambach
State Fish and Game Director

RFW/RWB/gk
cc: Congressional Delegation
Governor's Office
Burt Rounds
Keith Seaburg

BURLINGTON NORTHERN

JOHN [illegible] [illegible]ES
Vice President — Billings Region

[illegible]00 First Northwestern Bank Center
175 North 27th Street
Billings, Montana 59101

Mr. Paul Shore, Study Manager
Yellowstone Basin and Adjacent
Coal Area. Level B Study
Northfork Star Route
Cody, Wyoming 82414

March 1, 1978

Dear Mr. Shore:

Copies of your four volumes of the Level B Studies covering Montana have been furnished us, and we feel it is important to the integrity of the study to point out some significant errors in the methodology and findings as they concern coal and coal transportation.

Although the "high scenarios" in the Harza study relating to coal production are disavowed by your conclusion No. 3 on page X-1 in both the Lower Yellowstone and Tongue-Powder studies, the figures and other data relating to this scenario are referred to frequently throughout the text. We wish, therefore, to make it clear that the coal production volumes anticipated are much higher than we anticipate. Our expectations are based on mine-to-mine estimates done with the cooperation of the companies who will actually mine the coal in Montana and Wyoming.

If we can assume by your disclaimer in No. 3 conclusion on page X-1 that you are abandoning the "high" scenario in favor of the "most probable", this changes the base drastically. Either scenario below the "high" would, in our opinion, totally obviate the need for slurry pipelines as "supplemental" or other useful functions in the movement of Montana coal. As a logical follow-up, it would seem it would also destroy the rationale for your recommendation No. 1 under coal impacts, page X-4 in both studies, calling for recognition of water for interstate pipelines as a "beneficial" use in Montana and recommending such recognition by the State Legislature, which has already held such use to be illegal. Also, it was readily conceded at the February 23 meeting of the State Study Team in Billings that the Lower Yellowstone study data does not support or require slurry pipeline transportation, yet the recommendation appears in that study as well as the Tongue-Powder study.

I call attention to a letter to Mr. Jeff White from Mr. Don L. Brown of the Montana Department of Fish and Game, dated December 14, 1977, regarding Chapter X, page 2, items 4 and 5, stating: "Slurry lines appear to be endorsed without proper reference to any adverse impacts they may have, while rail transport is apparently dismissed without benefits it may offer." Likewise, I call your attention to Mr. Brown's further comment on February 22, 1978, referring to the final draft X-2, items 5 and 6, recommending again that these be changed. We feel Mr. Brown's suggestions are firmly based and appropriately taken.

Also, the study assumptions about rail capacity limitations are wrong for reason the study chooses completely to ignore a basic fact about rail capacity, i.e., rail capacity can be expanded faster than volume to be hauled. The "high scenario" coal volumes given in the study for the Lower Yellowstone, for example, exceed our wildest expectations; but even if the volumes were to be in the neighborhood of 100 million tons by 1985, BN could expand its capacity on the line east of Forsyth in plenty of time to handle that entire volume. In addition. there would still be room to move volume by means of our line that runs through Minot as well as over our Wyoming line.

The theoretical model used by Harza to calculate rail capacity does not recognize what practical experience shows to be true. A railroad system is not a static or fixed entity as their model assumes. In reality, when a line segment appears to be approaching its practical limit, adjustments are routinely made to accomodate those limits. We are constantly doing this on our coal lines, with each year's construction providing for the needs of the following year's traffic. This process has been recognized by almost every major study of coal transportation done in recent year, with the prominent exception of the Harza study. Dr. Paul Polzin of the University of Montana in an article in MONTANA BUSINESS QUARTERLY, Spring, 1977, pointed out a study he had done indicated that if the line east of Forsyth were double-tracked and equipped with centralized train control, "it could carry the entire projected annual output of Montana coal for the next thirty years with sufficient leeway to allow significant amounts of Wyoming coal to be routed through the state toward the Upper Midwest."

In summary, unrealistic assumptions about Montana coal production and rail capacity produce a compounding of errors that leads to the false conclusion that massive amounts of water should be exported by means of coal slurry pipelines. In the absence of any logical or factual substantiation, this conclusion is misleading and does significant harm to the overall believability of the study.

Very truly yours,

J. O. Davies

cc: Mr. James R. Walker
Mr. J. U. Dickson
Mr. John Delano
Mr. Jack Knott

United States Department of the Interior

~~BUREAU OF OUTDOOR RECREATION~~

MID-CONTINENT REGION

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Denver Colorado 80225

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Lakewood, Colorado
Telephone 234-2634

IN REPLY REFER TO

D6427

MAR 3 1978

Memorandum

To: Paul Shore, Study Manager

From: Agency Coordinator, Yellowstone Level B Study

Subject: Final Draft of Montana Study Team Reports

We have reviewed the above final draft provided with your memorandum of February 7, 1978. Editorial and figure changes are shown on the enclosed pages copied from the draft report.

Discussion of instream flow requirements in the report did not address recreation requirements directly, except for fishery maintenance. The Heritage Conservation and Recreation Service (HCRS, formerly Bureau of Outdoor Recreation), in cooperation with the Instream Flow Group, Western Energy and Land Use Team, U.S. Fish and Wildlife Service, is developing instream flow requirement methodologies for recreation. Future river recreation planning should utilize the results of this study to best consider what flows are required for various recreation activities and how existing or proposed developments will affect the river recreation environment.

One recommendation submitted by HCRS to be included in Chapter X of the draft report was not included and is therefore presented here.

Outdoor Recreation

Recreation and related environmental data for regional and river basin planning are not comparable to the data available for water development, flood control, and other purposes. In addition, considerable variation exists between States on recreation and related environmental data that do exist. Therefore, Federal, State, and private entities responsible for managing recreation areas should establish a uniform method of inventorying existing recreation resources, reporting use, and identifying recreational use capabilities. This system should be kept current and made available for all resources planning purposes.

Recreation costs and benefits for multipurpose projects were calculated by HCRS with respect to reservoir size estimates given by the assistant study manager. Estimated recreation days attributed to multipurpose reservoir projects were included in Chapter IX; however, estimated costs and benefits were not included in the recommended plan. A table of recreation data for each project is attached.

Although we are pleased with the wild, scenic, and recreation river proposals presented in the recommended plan, discussion of recreation resources needs is sparse and often too generalized.

The HCRS is pleased with the environmental integrity of these reports and would like to commend all those who participated in this study effort.

Emanuel Lauck

Enclosure

cc: Montana SLO

Planning Area	Bighorn-Clarks Fork		Upper Yellowstone		
Project	Elbow Creek	Blue Water - 5 Mile Creek	Flathead Creek	Prior Creek	Antelope Cree
Estimated WSA	340	255	300	250	300
Annual Recreation Days (General Recreation)	95,200	71,400	84,000	70,000	84,000
Annual Fisherman Days	74,800	56,100	66,000	55,000	66,000
Total Recreation Days	170,000	127,500	150,000	125,000	150,000
Land Acres Required for Recreation	366	274	323	269	323
Total Construction Costs	1,791,800	1,343,850	1,581,000	1,317,500	1,581,000
Land Acquisition	102,000	82,200	96,900	80,700	96,900
Annual Operation, Maintenance, and Replacement	102,900	77,100	90,800	75,600	90,800
Annual Equivalent Cost	Not Amortized	Not Amortized	Not Amortized	Not Amortized	Not Amortized
Annual Benefits	564,400	423,300	498,000	415,000	498,000

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

March 17, 1978

Mr. Paul Shore, Study Manager
Yellowstone Level B Study
Missouri River Basin Commission
Northfork Star Route
Cody, WY 82414

Dear Mr. Shore:

We have reviewed the final draft report (volumes 2 through 5) for the Montana portion of the Yellowstone Basin and Adjacent Coal Area Level B Study. In general, it appears that our concerns regarding the quality of baseline fish and wildlife data (and other environmental information) that would be developed and used in the study have been confirmed.

Although the information presented in the report admittedly represents what is most readily available, it is, in our opinion, neither comprehensive enough nor detailed enough for the intended purpose. Baseline information describing and quantifying even the major fish and wildlife habitat types in the area is extremely limited. Also, no quantified projected requirements for fish and wildlife habitat needs appear in the report, although such needs certainly exist and should have been a major thrust of the study. In addition, environmental baseline information was never assembled in such a manner to permit any meaningful assessments of the impacts and trade-offs of alternative plans. A more formal, systematic, and better documented procedure was, in our opinion, necessary to properly evaluate resource trade-offs and assess impacts.

In the early phases of the study, the Fish and Wildlife Service suggested methods for assembling at least some of the needed natural resource baseline data. It was hoped these suggestions would lead to further discussions and eventual adoption of some procedure for bringing together the essential information. However, the suggestions were rejected and no alternative solutions for gathering the data were proposed. Management personnel insisted that the study be conducted using "existing" data, but no adequate procedure for assembling such existing data was incorporated into the study.

Finally, we question whether the study was conducted entirely in accordance with guidelines set forth in the Water Resource Council's "Principles and Standards" which require that equal consideration be given to the National Economic Development and Environmental Quality Planning Objectives. We do not believe equal emphasis is reflected. To some extent, we believe this particular shortcoming was built into the plan of study. As you may recall, the Service expressed concern on this point on numerous occasions early in the study. In fact, it was our concern with procudrual shortcomings outlined herein that led us to limit our later involvement in the study.

Our specific comments on the draft report follow:

Chapter II - Natural Resource Baseline, Fish and Wildlife Resources (Volumes 2-5)

No quantified data are presented in these sections of the report volumes While the descriptive information presented is interesting and informative, it does not, in our opinion, give a good picture of the existing fish and wildlife resource base. Some quantified estimates of both terrestrial and aquatic habitats important for fish and wildlife are needed as a basis for later comparisons.

The bald eagle should be included among those species noted in the report as endangered or threatened. The eagle was recently added to the national endangered list. It is probable that bald eagles occur in all four Montana planning areas.

Chapter IV - Projected Requirements, Fish and Wildlife (Volumes 2-5)

The information presented in these sections of the report volumes does not appear to address the primary issue, i.e., "projected requirements" or future needs for fish and wildlife resources. No quantified data relating to resource (fish and wildlife species) needs or use (by man) needs are presented. A very limited and general discussion of the need for stream access is contained in each volume, but only the Upper Yellowstone report contains even a vague idea of specific locations.

It is our opinion that the needs of selected animal species or groups, or for selected habitat types, should be considered in a study of this nature.

Chapter V - Future Without (F/WO) and Remaining Needs, Fish and Wildlife (Volumes 2-5)

The inadequacies pertaining to quantified fish and wildlife resource needs cited previously in comments on chapters II and IV also apply to these sections of the volumes.

Chapter VII - The Recommended Plan (Volumes 2-5)

The only elements of this plan which we could support without detailed fish and wildlife studies are:

1) Removal of fish spawning barriers to tributary streams
2) Proposals for additions to the National Wild and Scenic Rivers System or designation of river segments as State Recreation Rivers

Chapter VIII - Recommended Plan Evaluation, Fish and Wildlife (Volumes 2-5)

It is interesting to note that this section does not describe, in any detail, how the recommended plan will meet future specific needs for fish and wildlife resources. It merely states that plan elements would "maintain and/or enhance existing habitat" or "create new habitat". This may or may not be true; however, in most instances, it can't be definitely stated based on the limited data presented in the report. It was, of course, probably impossible to describe in this section how the recommended plan would meet future fish and wildlife needs since no attempt was made to adequately describe or quantify these needs. However, it seems that any viable plan should certainly address this issue.

Chapter IX - Impacts of the Recommended Plan, Fish and Wildlife (Volumes 2-5)

This section does not in any meaningful way describe or quantify even the major impacts of the recommended plan on fish and wildlife resources. However, it seems obvious that such information should be considered essential for a study of this type. In this instance, the study procedure and the information base incorporated were inadequate to attempt meaningful evaluations.

Chapter X - Conclusions and Recommendations (Volumes 2-5)

Conclusions - We question the validity and advisability of conclusion number ten for two reasons. First, the essentially permanent allocation of a resource as valuable as water in the study area should, in our opinion, be viewed on a long-term need basis rather than a short-term or "immediate" need basis. Secondly, we do not believe fish and wildlife needs in terms of water were analyzed in sufficient detail in this study to permit ranking with other water uses.

Recommendations - Fish and Wildlife - The only recommendation listed which we could support without additional detailed studies is the modification of the diversion structure in the Yellowstone River at Intake, Montana to allow for passage of paddlefish.

In connection with Recommendation 3, page X-5, Volume 5, we reiterate our position as outlined in a letter to the Corps of Engineer's dated August 15, 1977. We note that a copy of that letter is included in your study report. We might also point out that the "24 sites" alluded to in your recommendation and in our letter presently appears to be an

"outdated" concept at best.

In summary, we do not believe the study supports approval of Level C studies since it has been conducted in an inadequate manner with respect to fish and wildlife resources specifically and environmental concerns generally.

Sincerely,

Barry Betts

Barry Betts
Acting Area Manager

cc: Regional Director, USFWS, Denver, CO (ENV)